NORTHWESTERN UNIVERSITY

Becoming Equestrian:
People and Horses in Bronze Age Hungary

A DISSERTATION

SUBMITTED TO THE GRADUATE SCHOOL
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

for the degree

DOCTOR OF PHILOSOPHY

Field of Anthropology

By

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EVANSTON, ILLINOIS

December 2018

ABSTRACT

Becoming Equestrian: People and Horses in Bronze Age Hungary

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People and horses have a deep, co-constructed, and co-evolutionary history. This dissertation evaluates sociopolitical change of the Hungarian Bronze Age (2800 – 800 BC) in the context of long-term shifts in human-horse relationships. In the Bronze Age, horses are assumed to mount the development of complex polities ruled by elite, chariot-driving warrior aristocracies which transformed the Old World. Equestrians are placed at the core of the political economy at the intersections of transport and control of trade, warfare, warrior institutions, and ideologies. In this dissertation, I test the political economy model, challenged with a multispecies archaeology, to investigate the role of novel human-horse interactions suspected to undergird these transformations.

With an integrated methodology, the first to combine zooarchaeology, bioarchaeology, stable isotope analysis, material culture study, and GIS mapping, I analyzed data I collected from seven settlements and ten cemeteries. I found the earliest horseback riders in history, the earliest postcranial pathologies in horses, the earliest evidence of specialized breeding and exchange in horses, and no evidence of chariotry. The earliest riding was not restricted by class or sex, and there is little indication of elite control of horse production, ownership, or use in the Hungarian Bronze Age. This creates an interpretive problem for the political economy approach, which anticipates that horses were co-opted by aspiring elites in their attempts to create wealth and finance rule. This phase of human-horse relationships was not yet defined by equestrian power as overarching sociopolitical power. Equestrianism came early in the Bronze Age; the politicalization

of horses came later. Not until the very end of the Bronze Age were horses clearly incorporated into pursuits of power and in warfare. Even then, horses emerge as important in resistance to centralized power as a vehicle to consolidate it.

The results of this dissertation undermine the proposed widespread dissemination of chariot warrior aristocracies at the beginning of the European Bronze Age. Dismounting the elite male warrior from his chariot complicates an old but persistent Bronze Age grand narrative that has at its heart an elite androcentric mastery of nature, animals, women, commoners, rural dwellers, and others through time. Ordinary horseback herders, commoners, and women made equal contributions to the development of complex societies of the European Bronze Age with and through horses.

ACKNOWLEDGEMENTS

This dissertation was possible because of so many truly incredible people. I was introduced to the Bronze Age of Hungary by Tim Earle when I arrived at Northwestern. As soon as he mentioned that something interesting was happening with horses there, I was sold in about five minutes. Since then, Tim has been an inspiration academically as well as personally. My work is forever imprinted by his big, comparative thinking and his logical progression through difficult concepts and problems when they arise. Bill Leonard has been a constant source of encouragement and kindness through this journey, as well as a model of academic and professional development. Mary Weismantel has always pushed me in the best way possible to think differently and has improved my work in countless ways. I have been a great beneficiary of the endless archaeological creativity, joy, and energy of Jim Brown and Cynthia Robin. Bill Irons also shared with me many wonderful stories of people and horses from his fieldwork. Erin Waxenbaum has been of great bioarchaeological assistance. All of the Northwestern Faculty have had a lasting influence on my work and I feel very lucky to have known so many remarkable scholars. This further extends to my classmates at Northwestern, Chis Morehart, Kristin DeLucia, Santiago Juarez, Doug Bolender, John Millhauser, Noah Butler, and Ana Tejeda whose work and conversations have all had meaningful effect on my work. I have to give a special acknowledgement to Tracy Tohtz who kept me moving forward when I thought it was not possible. I could not be more thankful.

My introduction to Hungary was made through the Benta Valley Regional Archaeological Project, via the Emergence of European Communities Project organized by the incomparable Kristian Kristiansen. Through the Benta Valley Project, I was introduced to the amazing people of the Százhalombatta Archaeological Expedition and the Matrica Museum and Archaeological Park.

Director Magdolna Vicze made my work possible in so many ways. Her archaeological and academic rigor as well as her patience and generosity have significantly impacted this dissertation. Maria Vretemark and Sabine Sten did all of the initial faunal analysis from Százhalombatta-Földvár. My work there was made much easier because of their hard work, thorough database, and insightful results. Through the Matrica and the Benta Project, I met and worked with Dániel Fükóh, Tamas Polanyi, Bori Nyiri, Magnus Artusson, Håkan Aspeborg, Carla Klehm, Julia Fraser, Louis Wertz, Brian Dubin, and Greg Lane. These are special, funny, and lovely people I have had the pleasure of knowing and learning from. We had an awesome time in the field. The Nyiri family gave me a home away from home in Budapest, complete with all the warm feelings and a great dog. Carla Klehm has been just the best colleague and friend a person could have.

My research in Hungary was made possible and exceedingly pleasant by so many people. Ildikó Pap, Hungarian Natural History Museum, Department of Anthropology facilitated my bioarchaeolgical research. I am indebted to her for her openness to my research and for her kindheartedness. From the Déri Museum in Debrecen, I thank Lajos Lakner, Museum Director and Deputy Director of Research, Zsigmond Hajdú, Director of Archaeology, Janos Dáni, Deputy Director of Archeology, for granting me access to their collections and hosting me and for Krisztián Antal Szilágyi for organizing my visit to the Déri Museum, showing me the Berettyó Valley tells, and having endless patience in doing so. At the Aquincum Museum, Paula Zsidi, Archaeologist, Senior Museologist, Director of the Aquincum Museum (now retired) and Anna Endrődi, Head of the Department of Prehistory and Migration Period, Archaeologist, and Senior Museologist were exceptionally accommodating in the access to their collections. Péter Csippán was a great help and introduction to the collections and research in the area. Alice Choyke and

László Bartosiewicz are the geniuses of Hungarian zooarchaeology. They have been so good to me professionally and personally and are models for zooarchaeologists the world over. Working in Hungary was one of the greatest joys of my life. I am constantly stimulated by research of the highest quality that keeps coming from all these scholars and many others who I know from publications only, but am similarly indebted.

The genesis of my human-animal research was born at Purdue University. Rich Blanton is a foundation in my work and was a superior advisor for my Master's. He and Cindy Bedell made my life so rich in West Lafayette. I have many happy memories of long conversations about archaeology and life over beers at Sergeant Preston's with Lane Fargher and Verenice Heredia Espinoza. From the horse world, Colleen Brady and Mark Russell also from Purdue, influenced and encouraged my work from the horse side of things and have certainly had a lasting impact on all things horse related. My polo students from around the world have had a similar influence on my life and work. In long hours at the barn and on horses, this project germinated before it existed.

Writing this dissertation in my hometown of Rensselaer, Indiana was made quite delightful by the superb staff of the Jasper County Public Library, Rensselaer Branch. I would not have survived without my extraordinary friends in Rensselaer and the never-ending support of my parents, Judge Michael and Judy Kanne. I would be remiss if I neglected to mention the support Terry Tope gave to me to start this journey. Throughout it all, the constants have been my horses, some whom I have lost to the infirmities of advanced age, Mister, Roca, and Belle, and some who continue on with me, Lascaux, Pete, and Senessa. Similarly, my dear dogs give me great happiness, Spike and Alfie, and dogs who have gone on, Melly, Gonzo, and Speck. My superior cat, Swank, is an inspiration in toughness and has outlasted everyone so far, including D'arcy and Momma

Cat. I have been very fortunate to have known so many good people and so many good animals on this voyage.

Lastly, I am grateful that this dissertation research was funded by the National Science Foundation, Dissertation Improvement Grant # 0833106 (thanks to Eliza Earle for NSF help!) and the Wenner-Gren Foundation for Anthropological Research, Dissertation Fieldwork Grant. Northwestern University Provided a number of resources that enabled my work including The Graduate School Fellowships and Graduate Research Grant, Weinberg College of Arts and Sciences Information Technology Grant, the Institute for the Humanities Graduate Associate Funds, and the Department of Anthropology's Foster/FAN Grant.

LIST OF ABBREVIATIONS

AE/DE	Anterior Enamel or Dentine Exposure
BW	Bit Wear
BW-C/PC	Bit Wear and Cranial/Post-Cranial Pathologies Combined
BK	Middle Bronze Age site of Bakonszeg-Kádárdomb
BMD	Bone Mineral Density
BR	Berettyó Valley sites of Bakonszeg-Kádárdomb, Berettyóújfalu-Szilhálom, and Gáborján-Csapszékpart
BS	Middle Bronze Age site of Berettyóújfalu-Szilhálom
cal BC	Radiocarbon date BC calibrated to exact years with tree ring rata
CD	Centrodistal joint of the horse's hock
CW	Cranial Wear
DJD	Degenerative Joint Disease
DS	Early Bronze Age site of Dunakeszi-Székesdűlő
EA	Elongation of the Acetabulum
EBA	Early Bronze Age, 2800/2700 – 2000/1900 BC
EC	Entheseal Changes
ECA	Early Copper Age, 4500/4400 – 4000 BC
EDH	Enamel Dentine Height
EDW	Enamel Dentine Width
EIA	Early Iron Age, 900/800 – 700 BC
EPW	Encrusted Pottery Ware Culture
FUI	Food Utility Index

FZBY	Füzesabony Culture
GC	Middle Bronze Age site of Gáborján-Csapszékpart
Gl	Greatest length of long bones used to calculate withers height
GLl	Greatest Lateral length of long bones used to calculate withers height
GIS	Global Information Systems
GYVD	Gyulavarsánd Culture
HH	Hands High; a hand equals 4 inches, 10.16 cm; for example: 14.2 hh = 14 hands, 2 inches or 147.32 cm
HOAC	Horizontal Acetabular Diameter
HRC	Horse Relative to Cattle
IA	Iron Age, 900/800 BC – late 1st centry AD
IAE	Indices d'Activités Équestres
IE	Indo-European
KU	Middle Bronze Age site of Királyok Útja 293
KSS	Kissing Spines Syndrome (or overriding or impinging dorsal spinous processes)
LBA	Late Bronze Age, 1450/1300 – 900/800 BC
LCA	Late Copper Age, 3600/3500 – 2800/2700 BC
LP2s	Lower Second Premolars (on Mandible)
MAD	Mad’arovce Culture
MBA	Middle Bronze Age, 2000/1900 – 1500/1450 BC
MCA	Middle Copper Age, 4000 – 3600/3500 BC
MI	Marrow Index
MGUI	Modified General Utility Index

MNI	Minimum Number of Individuals
MOS	Markers of Stress
MP	Late Bronze Age site of MOBP06-Pécel02
MRI	Magnetic Resonance Imaging
MSM	Musculoskeletal Stress Markers
MUI	Meat Utility Index
NISP	Number of Identified Specimens
OA	Osteoarthritis
OCD	Osteochondrosis
P1	Proximal Phalanx (also called Pastern Bone)
PC	Post-Cranial
PIE	Proto-Indo-European
PR	Probable Riders
RS	Rider's Syndrome
RSI	Repetitive Strain Injury
RVH	Ratio of Height (VEAC) to the Width (HOAC) of the Acetabulum
SD	Smallest Breadth of the Diaphysis of metapodia (metacarpals and metatarsals)
SFUI	Standard Food Utility Index
SI	Slenderness Index
SM	Spiral Motif, in German the *Karpatenländische-ostmediterrane Wellbandornamentik* (the Carpathian-East Mediterranean Wave Band Motif)
SPR	Secondary Products Revolution

$^{87}Sr/^{86}Sr$	Strontium Isotope
SZHB	Bronze Age site of Százhalombatta-Földvár
TDT	Tarsometatarsal joint of the hock
TRB	Funnelbeaker Culture, *Trichterbecherkultur* in German
UP2s	Upper Second Premolars (on Maxilla)
VEAC	Vertical Acetabular Diameter
WH	Withers Height
WST	World Systems Theory

GLOSSARY

Bars: diastema or mandibular interdental space where the bit lies in a horse's mouth

Bevel: bit wear on the anterior corner of the lower premolar (LP2) of a horse that is measurable

Cannon Bone: Third Metacarpals (forelegs) and Third Metatarsals (hindlegs)

Cheekpiece: side of the bridle bit that lies on either side of the horse's mouth and connects mouthpiece to reins and headstall of the bridle

Curb Bit: a bit for the horse that works on leverage; the rein is attached to another hole in the cheekpiece than the mouthpiece, increasing the force applied to the bit; compare to snaffle bit

Coffin Joint: the distal interphalangeal joint

Dressage: an equestrian Olympic sport, or discipline, where a horse and rider perform a test which is a pattern of movements from memory; originally a French word, commonly translated as 'training'

Einfache Scheibenknebel: (German) Plain Disc Cheekpiece, but probably a bridle strap divider

Equestrian: of horseback riding or horseback riders; from Latin *equester*, of or "pertaining to equestrians/cavalry" + *-ianus* "-ian, related to", adjective marker), from *equus* ("horse"); English term derived from the PIE root *h_1eḱ-" meaning horse

Equestrianism: the skill of riding horses

Equitation: the art and practice of riding horses

Eventing: an equestrian Olympic sport, or discipline, where a single horse and rider compete in dressage, cross-country (jumping over a course of fences across open ground), and show jumping; also called "Combined Training"

Fetlock: metacarpophalangeal joint

Floruit: the "peak" or "classic" of a time period

Hock: the tarsal joint

Kontaminationsform:	(German) combination form bit cheekpiece made of red-deer antler
Kurgan:	a burial mound, barrow, or tumulus of earth and stones first associated with Yamnaya migrations into Hungary, but also date to later periods
Ovacaprid:	sheep and goats, classed together in faunal analysis because of the difficulty of distinguishing their bones by species
Pastern and Pastern Joint:	the proximal phalanx and the proximal interphalangeal joint
Plattenknebel:	(German) rectangular bit cheekpiece made of bone
Poleaxing:	killing a horse by striking a fatal blow to the cranium
Politicalization:	incorporation of horses into politics and warfare
Reinmenteiler:	(German) bridle strap dividers
Scheibenknebel:	(German) circular or disc-shaped bit cheekpieces made of bone
Show Jumping:	an Olympic equestrian event, or discipline, where horse and rider jump over a course of fences in an arena
Snaffle Bit:	a bit that acts with direct pressure; has a mouthpiece attached to cheekpieces which directly attach to reins
Stangenknebel:	(German) rod-shaped bit cheekpiece made of red-deer antler
Synthetic Resources**:**	the idea that animals provide both material and social sustenance
Tell:	multilayered settlement settlements with at least three archaeological levels and a deposit of over 1 m
Trensenkreis:	(German) bridle circle dividing distribution of rod-shaped riding cheekpieces and in the Carpathian Basin from disc-shaped chariot cheekpieces on the Don-Volga-Ural Steppes
Zapfenknebel:	(German) variant of a rod-shaped cheekpiece

DEDICATION

For my horses, my teachers.

Alois Podhajsky 1968

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CHAPTER 1

Introduction

Animals are important in political life, none more so than the horse. Much has been written about the impact of horses in human societies and always mentioned is the increase in travel, trade, communication, ideas and warfare. Kingdoms, empires, and continents have been won and lost on horses. The business of horses became the business of those in power or those who wanted to be. But not so much has been written on how this came to be or why horses became such a political animal. Broadly, this project is an effort to trace the *politicalization* of horses back in time to a period when the horse moved from a herder's mount to a continent's fortune. By politicalization, I mean the process by which horses became embedded in human pursuits of power.

The European Bronze Age is a period when changing relationships between people and horses may signal the incorporation of horses into hierarchies of power, namely in political economies and in warfare. In this dissertation, I examine the Hungarian Bronze Age (2800/2700 – 900/800 BC), a period of significant transitions in both human-horse relationships and human societies. At the time when complex tell based societies were formed, horses seem to have become widely distributed and appear to have attained a new cultural significance (Bökönyi 1978; 1988a; Choyke 2000; 2005b; Choyke, Vretemark, and Sten 2004; Vretemark 2010; Vretemark and Sten 2005). Recently, a horse excavated from a settlement dating from the transition between the Early Bronze Age (EBA) and the Middle Bronze Age (MBA), 2139-1981 cal BC, has been found to be the horse that is most ancestral to all domesticated horses (Gaunitz et al. 2018). Something new was clearly going on between people and horses in the Hungarian Bronze Age. Thus, the main questions of this dissertation are: 1) How are the changes in human-horse relationships related to

the development of complex societies in Bronze Age Hungary? and, 2) how do these changes fit into larger shifts in human horse co-evolution and co-history making?

My central thesis is that ordinary people, with and through horses, brought the development of the complex societies of the Hungarian Bronze Age. The Bronze Age was co-constructed and constituted with, on, and through horses. Equestrianism came early in the Bronze Age; the politicalization of horses came later. In this dissertation, I found riding to be widespread by the MBA, c. 2000 BC, and not restricted by class or sex, or related to warfare. This supports the idea that horses were not widely co-opted into political economies and warfare until the very end of the Late Bronze Age (LBA) and into the Iron Age, c 1200 – 1000 BC. For most of the Hungarian Bronze Age, I argue that horses made resistance to centralized and hierarchical rule possible, until rule by equestrians made horses inevitably bound to politics and warfare thereafter. Equestrianism and horse husbandry were important to the genesis of sociopolitical complexity in Bronze Age Hungary, but they were not tied to aspiring elite rulers or associated with chariots. This phase of human-horse relationships was not yet defined by equestrian power as overarching political power. Dismounting the elite male warrior from his chariot complicates a "Grand Narrative" of the European Bronze Age which envisions chariot riding elite warrior aristocracies inciting the development of the complex tell societies in Central Europe and spurring the transformations seen across Bronze Age Eurasia (Allentoft et al. 2015:Supplement; Earle and Kristiansen 2010; Kristiansen 1994; 1999; 2000a; 2007; 2011; 2012; 2016; Kristiansen and Earle 2015; Kristiansen and Larsson 2005; Vandkilde 2014).

The changing relationships between people and horses in the inception of the complex societies of MBA Hungary lie in context of the broader shifts in human-horse relationships through

time. These shifts in human-horse relationships of the Hungarian Bronze Age are part of the generative and accumulative co-evolution of people and horses. From physical and cultural sustenance, to herding and travel, to politics and warfare, and recently of sport and leisure, each phase is characterized by a new kind of interspecies sociality which allows both people and horses to achieve novel things together through space and time. I site this study in such a period of co-altered multispecies relationships.

Background to Research

People and horses changed together through each other; we have a deep, co-constructed, and co-evolutionary history that has had major shifts at particular junctions in time. People first followed, hunted, and painted horses in the first tens of thousands of years of their interactions (Bendrey 2012; Benecke and von den Driesch 2003; Clutton-Brock 1992; Guthrie 2006; Levine 1999a; Levine et al. 1999; 2003; Olsen 1989; 1996; 2014; Pruvost et al. 2011; West 2006). By 3500 BC at the latest, horses were domesticated; people were milking them and most likely riding them to herd other horses (Achilli et al. 2012; Anthony 2007; Anthony and Brown 1989; 1991; 2000; 2011; Anthony, Brown, and George 2006; Cieslak et al. 2010; Gaunitz et al. 2018; Librado et al. 2016; 2017; Ludwig et al. 2009; Orlando 2018; Outram et al. 2009; Warmuth et al. 2011; 2012; Wutke et al. 2018). At the same time, people with horses migrated into Central Europe, instituting a massive genetic, linguistic, and cultural shift (Allentoft et al. 2015; Anthony 2007; Anthony and Ringe 2015; Ecsedy, Bökönyi, and Ecsedy 1979; Ecsedy 1994; Gerling 2015; Gerling et al. 2012a; 2012b; Goldberg et al. 2017; Greenfield 2006; Haak et al. 2015; Heyd 2014; Olalde et al. 2018).

Previous work suggests people began to use and to think about horses in new ways from the Copper Age into the Bronze Age (Bökönyi 1968; Bökönyi 1974; Choyke 1984; Choyke 2005b; Choyke, Vretemark, and Sten 2004; Csányi 2003a; Kulcsár 2003; Vretemark and Sten 2005; Vretemark 2010). Horses were the last and only new domesticated animals to appear (Bökönyi 1978). Absent as a wild species in the Carpathian Basin by the Copper Age (4500/4400 BC – 2800/2700 BC), they originally trickled into the lower Danube Valley in low numbers in specialized contexts, mostly as a few bones in elite burials (Anthony 2007; Bökönyi 1974, 1978, 1988; Greenfield 1999). Interactions with peoples from the northern Pontic zones are indicated as early as 4200 BC and were likely related to the arrival of the first domesticated horses in Copper Age settlements (Gerling et al. 2012; Heyd 2014).

Certainly domesticated, milked, and most likely ridden by 3500 BC in Kazakhstan, horses allowed people to organize their pastoralism on a large scale (Anthony 2007; Outram et al. 2009). A mobile, horse-riding and herding, wagon-based, form of steppe pastoralism of cattle and sheep developed on the Pontic-Caspin steppes around 3300 BC and subsequently set off a migration of these peoples into the Carpathian Basin, spreading Proto-Indo-European languages and horse husbandry (Anthony 2017; Anthony and Brown 2017; Anthony and Ringe 2015; Goldberg et al. 2017; Haak et al. 2015). Having arrived possibly for horse-trading (Ecsedy et al. 1979), these peoples rode horses to herd cattle and sheep to the Lower Danube Valley around 3500 BC and sacrificed them in their new *kurgan* burial rites (Anthony 2007; Frînculeasa, Preda, and Heyd 2015; Gerling et al. 2012a; Gerling et al. 2012b). Local farmers and these new horse people were the populations that built the societies of Bronze Age Europe (Allentoft et al. 2015; Anthony and

Brown 2017; Bökönyi 1974; Bökönyi 1978; Endrődi 2013; Endrődi, Gyulai, and Reményi 2008; Endrődi and Reményi 2016a; Goldberg et al. 2017; Olalde et al. 2018).

About 2500 BC, in the Early Bronze Age (EBA: 2800/2700 – 2000/1900 BC), related Bell Beaker groups settled in a concentrated area at the Danube bend around now what is Budapest. At their settlements, incredibly large numbers of horses have been found showing signs of work and a full breeding population (Endrődi 2013; Endrődi and Reményi 2016a). As the tell based polities were formed and expanded around 2000 BC, horses appeared to spread throughout the region. Indeed, recent research has confirmed the importance of Bronze Age Hungary for the genesis of domesticated horses. The DNA from the bones of a horse excavated from the settlement of Dunaújváros-Kosziderpadlás dating to 2139-1981 cal BC have revealed it to be ancestral to all modern domesticated horses (Gaunitz et al. 2018).

In this process, horses grew larger and more numerous throughout the Carpathian Basin (Bökönyi 1988a). People generally stopped eating horses and they appeared to gain a "special status" among domesticates in tell societies (Choyke et al. 2004). The earliest horse bits have been found in the Carpathian Basin and manufacture of horse bits likely occurred at a number of the tell settlements (Bándi 1963; Bökönyi 1953; Mozsolics 1953; Hüttel 1981). All of this suggests a specialization in horses and their associated material culture developed during the Hungarian MBA. At the end of the Late Bronze Age (LBA: 1450/1300-9/800 BC), c. 1000 BC, and into the Iron Age (900/800-27 BC), skulls and limbs and then whole horses were buried with warriors throughout the region (Kmeťová 2013a; 2013b; 2017; Kmeťová and Stegmann-Rajtár 2014).

During the Bronze Age, human-horse relationships have been assumed to have undergone a directional shift, one towards increased involvement in politics, warfare, and social inequalities

(Bóna 1975; 1992; Earle and Kristiansen 2010; Earle et al. 2015; Fischl et al. 2013; Gogâltan 2008; 2018; Kristiansen and Earle 2015; Poroszlai 2003a; Uhnér 2005; 2012). Changing relationships between people and horses correlate to the origins of complex regional polities that are suggested to have emergent political economies with new patterns of inequality and rule (Earle and Kristiansen 2010). Large polities were formed in areas of excellent agricultural lands in strategic positions along the Danube and Tisza River and their tributaries during the Middle Bronze Age (19/1800 BC-15/1450 BC) (Earle et al. 2015; Earle and Kristiansen 2010). They contained densely packed, and sometimes fortified, central towns, called *tells,* that were surrounded by other large villages, hamlets, and farmsteads with ample pasturage. People engaged primarily in animal husbandry that they augmented with crop agriculture (Vretemark 2010). Bronze production flourished in this period as extensive trading networks grew to connect the Carpathian Basin to the far reaches of Eurasia, Scandinavia, the British Isles, and the Mediterranean. (Kemenczei 2003a; Kristiansen 2007; 2016; Kristiansen and Earle 2015; Ling and Uhnér 2014; Rowlands and Ling 2013). Bronze, amber, and wool, and salt (and potentially horses) moved along newly important overland and riverine trade routes (Kiss 2012a; Kiss and Fischl 2015; Harding 2013; Szigeti et al. 2017; Quinn 2017; Vretemark 2010).

These fortified tells are theorized to have been home to a class of elite warriors who controlled the circulation of wealth, labor, and contemporaneous off-tell communities (Earle and Kristiansen 2010; Vandkilde 2011; 2014). The production and international trade in bronze is thought to have escalated out of a network of competing elites at different tell based polities (Earle et al. 2015; Earle and Kristiansen 2010; Kristiansen and Earle 2015; Kristiansen and Larsson 2005). Social stratification apparently became widespread at these polities as the warrior elite

asserted power to expand and control trade in agricultural surplus to secure metals. The emergence of the elite warrior and subsequent efforts to control the metal trade indicate a new widespread mobility by river, ocean, and overland. While new kinds of boats and maritime technologies are believed to have been critical in the metal trade (Earle et al. 2015), the diversity of terrains and routes to reach ores, metals, and trading partners would have been quite impossible to traverse by water alone and unlikely to have been carried out solely on foot overland. This strongly suggests a growing emphasis upon equestrianism for transport and protection of trade. Thus the rise of the Bronze Age warrior has often been coupled to their adoption of horses (Bóna 1975; Kristiansen 1999; 2000a; 2016; Kristiansen and Larsson 2005; Pare 1991; 1992; 2000; 2004; Treherne 1995; Uhnér 2012).

In the initial formulation of this dissertation project, I expected horses to become politicized with development of complex tell societies in Bronze Age Hungary and elsewhere in the Old World around 2000 BC, including with that the spread of metallurgy, the development of international contacts, the institutionalization of social stratification (of class, gender, and faction), and the birth and ascension of the warrior elite. They should have been essential to the development, growth, and maintenance of complex societies and their political economies. This is in line with a Grand Narrative of the European Bronze Age which has strongly asserted that elite chariot riding warrior aristocracies with their attached specialists, originating from the Eurasian steppes but influenced by Near Eastern and Aegean societies, incited the organization of the complex tell societies with emergent political economies and institutionalized social stratification (Allentoft et al. 2015:Supplement; Earle and Kristiansen 2010; Kristiansen 1999; 2000a; 2007; 2012; 2016; Kristiansen and Earle 2015; Kristiansen and Larsson 2005).

However, recent research has emphasized that these developments were more limited and more heterogeneous throughout Hungary than old grand narratives have allowed (Bartelheim 2009; Brück and Fontijn 2002; Duffy 2010; 2015; Frieman et al. 2017; Galaty, Tomas, and Parkinson 2014; Harding 2006; 2013a; Jaeger 2018; Jaeger et al. 2018; Kienlin 2012; 2015; 2017; Kienlin, Korczyńska, and Cappenberg 2014; Kienlin and Zimmerman 2012; Nordquist and Whittaker 2007; Quinn 2017; Quinn and Ciugudean 2018). This now permits a rather different grand narrative to emerge which emphasizes that ordinary people and their labors organized the complex socieites of the Hungarian Bronze Age, not some foreign derived elite warrior class. These societies had less obvious hierarchal and centralized rule and social inequalities, but were unquestionably complex. Additionally, while it is of no small consequence that horses underline the genomic and probable linguistic turnover of Europe with the migrations c. 3300 BC of the Yamnaya peoples, that this connection ultimately resulted in stratified societies over a millennium later is not a given. These peoples may have had new conceptions of family, property, and gender (Earle and Kristiansen 2010:20; Kristiansen 2016:171–172; Kristiansen and Larsson 2005:142–280). However, this does not necessarily mean that these principles would remain in place or foundational for later sedentary Bronze Age societies. The complex communities of the Hungarian Bronze Age may have been as much a reaction against these hierarchies of power, rather than a continuation and expansion of them. Horses would have facilitated such resistance.

In this dissertation, I propose that indigenous equestrianism and horse husbandry were present at the genesis of sociopolitical complexity in Bronze Age Hungary. The Bronze Age was a period of becoming equestrian. Horse husbandry was well established by the EBA and then, diffused and spread with the expansion of the tell based polities of the MBA. They were a major

vehicle for the new widespread mobility and the dramatic increase in trade. As such, horses should have been a critical foundation to the development of political economies, but as I will demonstrate, they were not. They also may have been commodities traded for metals, with some evidence of specialized breeding. The Bronze Age warrior then, should be an equestrian. However, the lack of evidence for this until the end of the period substantiates that warfare generally was limited until well into the LBA. Equestrianism and horses should have been co-opted into ideologies and ritual processes that animated the status of the emergent elite. Horses thus should have become embedded in the institutionalization of social inequality, gender roles, and factional allegiances. This was the process by which horses became political animals, which was repeated in many places. However, this process occurred late in the Hungarian Bronze Age and into the Iron Age, and not with the emergence of the complex tell societies. I suggest this occurred at this much later time in most places in the Old World.

Horses then complicate the grand narrative of the chariot riding warrior aristocracies sparking the origin of the European Bronze Age and, with that, the nature of political inequality and increased social stratification often thought to characterize it. New relationships between people and horses that developed from the Copper Age into the EBA were important to the organization of complex societies of the Hungarian Bronze Age, just not in overtly hierarchical political power as previously assumed. Indeed, it was likely this local, autochthonous equestrianism that kept chariotry from intruding into the region and any one group or faction from gaining ultimate control of their peers.

Theoretical Framework

This research is situated within anthropological archaeological approaches to social change and human-animal relationships. First, this study is concerned with the role that horses play in the transformations that spur the development of complex regional polities with centralized hierarchical governance and the institutionalization of inequality. Political economic models have been the main focus of studying these changes in Bronze Age societies in the last few decades (Duffy 2010; 2015; Earle 2002; Earle and Kristiansen 2010; Earle et al. 2015; Kristiansen and Earle 2015; Nicodemus 2014; Quinn 2017; Quinn and Ciugudean 2018). The political economy is constructed when aspiring rulers seize control and maintain differential access over the flow of resources and labor to finance their rule (Earle 2002). As a result, they are able consolidate wealth and power and social stratification becomes institutionalized in this process. Metal systems, exotic goods like amber, and the products of the agricultural economy, including horses, are considered the main resources for Bronze Age political economies which are thought to have been administered by a ruling warrior elite (Earle and Kristiansen 2010; Earle et al. 2015; Kristiansen and Earle 2015). In addition to their commodity value, horses are assumed to underpin these developments in their use by a warrior elite to control, protect, and transport the raw materials and finished products in the metal trade. I use the political economy model to develop testable hypotheses to guide this research.

Second, this work is informed by the current anthropological study of human-animal relationships. The recent tradition of scholarship termed social zooarchaeology, and most recently a multispecies archaeology, examines how people affect and are affected by their relationships with non-human animals (Argent 2010; 2012; 2016; Armstrong Oma 2006; 2010; 2013;

Armstrong Oma and Birke 2013; Brittain and Overton 2013; Boyd 2017; 2018; Marciniak 2005; 2011; Orton 2010; Overton and Hamilakis 2013; Overton and Taylor 2018; Pilaar Birch 2018; Russell 2011; Weismantel 2015). Many assumptions about human-horse relationships in Bronze Age research are consistent with older anthropological theories about the causes of variation in how people think about and use animals. This scholarship followed two general explanatory trajectories – one emphasizing the uses of animals, a classical processualist and formalist argument, and the other emphasizing their meaning, a substantivist or post-processual critique (reviews in Mullin 1999; 2002; Shanklin 1985). Recently, there has been a more general recognition in archaeology that animals are *synthetic resources* for human societies, that is, they provide both material and social sustenance (Kanne 2005). Moreover, there has been a growing emphasis upon the active and agentive ways animals interact with people and archaeologists have come to view them as social actors in their own right (Argent 2010; Armstrong Oma 2010; Brittain and Overton 2013; Hill 2013; Overton and Hamilakis 2013). This is part of a larger conversation in anthropology and the social sciences, often termed the 'animal turn', which includes multispecies ethnography and ontological perspectivism (Anderson 1997; Descola and Palsson 1996; Haraway 2008; 2016; Kirksey 2015; Kirksey and Helmreich 2010; Kohn 2007; 2013; Nadasdy 2007; Noske 1997; Ogden, Hall, and Tanita 2013; Tsing 2015; van Dooren, Kirksey, and Münster 2016; Viveros de Castro 1998; 2012; Willerslev 2007). I take the results that disseminate from testing the political economic model to place the changes in the human-horse relationships of the Hungarian Bronze Age in broader shifts of human-horse co-evolutionary histories. I contextualize by this recent scholarship in human-animal studies.

Methodological Framework

I employ an integrative, multi-scalar and comparative approach using multiple lines of inquiry including zooarchaeology, osteology, material culture studies, strontium isotope analyses, and Global Information Systems (GIS) mapping. Each specific method will be outlined prior to the analyses in the upcoming chapters. I consider horses across the four major classes of archaeological data: *biological culture* (living species: animals and plants and specifically horses), *humans*, related *material culture*, and the *environmental contexts* in which they existed. I combine existing published zooarchaeological evidence of horses at the macro-regional level from seventy-four EBA, MBA, and LBA sites throughout the Carpathian Basin with zooarchaeological horse data I collected from five tells across northern Hungary to document their arrival and spread throughout the region: EBA/MBA/LBA Százhalombatta-Földvár, MBA Királyok-Útja 293, MBA Bakonszeg-Kádárdomb, MBA Gáborján-Csapszékpart, MBA Berettyóújfalu-Szilhálom; a LCA/EBA/LBA site, Dunakeszi-Székes-dűlő; and the LBA site of MOBP06-Pécel02 (Figure 1.1).

Metric quantification of horse bones allows me to investigate their size and regularity of type that may determine the presence of localized breeding populations and any commoditization of horses. The pathologies present in horse bones and bit-wear analysis of horse teeth provide evidence of their use. I look at the physical context of horse bone deposition and the treatment of the bones for evidence of changing beliefs about horses. Strontium isotope analysis ($^{87}Sr/^{86}Sr$) of thirty horse teeth taken from the seven sites listed above will be used to confirm that horses were locally bred and not imported and to provide corroboration for their key economic use and mobilization in international trade.

With respect to material culture, I document and map the horse bits that are found throughout Hungary during this period. I compare the bits and bit wear to all the bit finds of the Old World during the Bronze Age to clarify if horses were ridden or used to pull chariots in the Carpathian Basin. A horse bone tool industry also has been found to occur after people adopt horses in the Bronze Age. Many of these tools appear to be decorative or perhaps ritually used (Choyke and Bartosiewicz 2009). I study these tools to understand the possible meanings horses may have held to the peoples of the period.

With respect to humans, I conduct an bioarchaeological analaysis of the pathologies and markers of stress of human bones from Middle and Late Bronze Age cemeteries to ascertain if people were riding, who was riding, and potentially who was caring for horses. By looking at health and studying the grave goods related to each individual makes it possible to tie horse ownership and riding to gender, class, or faction. Two hundred and two specimens (202) were examined for habitual riding from the following cemeteries, housed in the collections of the Hungarian Natural History Museum: Tiszavasvári-Deák Halom-Dűlő (Neolithic 5000-4500 BC), Tiszafüred-Majoroshalom sections B and D (MBA Füzesabony), Gelej-Kanális Dűlő (MBA Füzesabony), Érd-Hosszúföldek (MBA Vatya), Tiszafüred-Majoroshalom sections C and E (LBA Tumulus), Mezőcsát-Hörcsögös (LBA Tumulus), Jánoshida-Berek (LBA Tumulus), Solymár (Avar 568-800/850 AD), Sopronkőhida (Avar), and the Tiszavasvári combined sites (Avar) (Figure 1.1). The Neolithic site of Tiszavasvári-Deák Halom-Dűlő was used as a control for non-riders, as domesticated horses were not present in Neolithic Hungary. The Avar period sites were selected as a control for known riders as they are cemeteries from a population of documented riders, often buried with horses and tack, and have institutionalized social stratification.

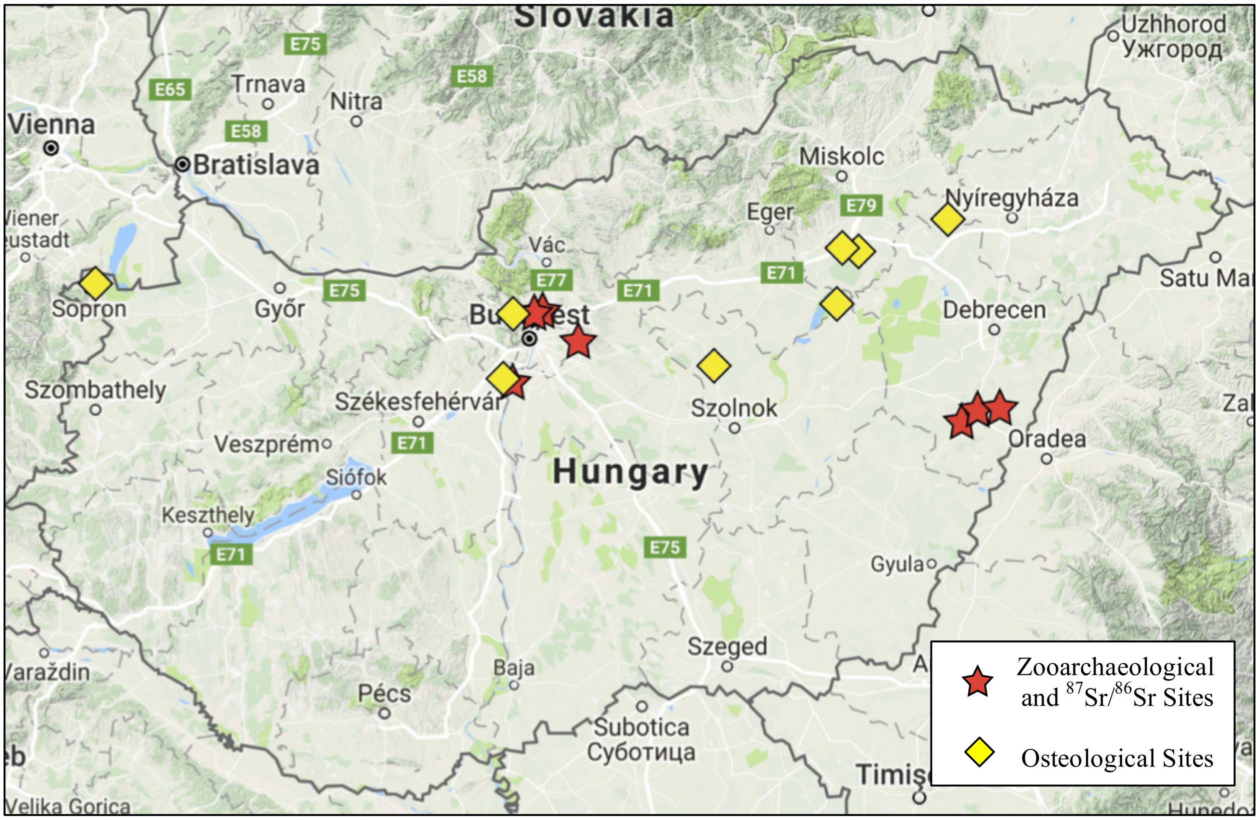

Figure 1.1. Sites in Hungary from which Zooarchaeological, $^{87}Sr/^{86}Sr$, and Osteological Data was Collected (Google Maps 2018).

This study is also micro-regional as I explore human-horse relationships and polity formation at the regional polity of the Benta Valley centered on the tell settlement of Százhalombatta-Földvár, because of the thorough and modern way it was excavated. At Százhalombatta, I study the relationships of humans, horses, other animals and plants, material cultural, and environmental and cultural contexts at both the tell and off tell settlements. Then I evaluate differences at the macro-level in horse exploitation across the Carpathian Basin and see how people at different polities used and considered horses. Furthermore, I place what I anticipate to be the horse infused polity building of the region in the broader context of horse utilization

throughout the Bronze Age of the Old World. I place this juncture in a larger picture of intensifying and extending human-horse relationships through time.

Organization of the Dissertation

After this introduction in Chapter 1, Chapter 2 discusses the theoretical framework in depth. I present the roles that horses have been assumed to play in the Grand Narratives of the transformations of Bronze Age Europe. These narratives have made extensive use of political economic theory. For this dissertation, I employ the political economy approach, its expectations for animals, and its specific expectations for horses in the Hungarian Bronze Age to develop the hypotheses tested. I then consider them in a multispecies archaeology perspective, which is in some tension with political economic theory; a tension I work through in this dissertation.

Chapters 3 and 4 provide a broad background of human-horse relationships through time and into the Hungarian Bronze Age. In Chapter 3, I introduce the co-evolutionary phases of human-horse relationships as they develop through sustenance, domestication, and into herding and travel. Riding domesticated horses, people were able to travel great distances and move large herds of livestock. They arrived into the Carpathian Basin in the Copper Age with new cultural traditions and ways of life based in animal husbandry. I show that indigenous equestrianism and horse husbandry were well established and characterized the settlements built in the EBA. Contextualized by the environmental characteristics, I examine this influx of people and horses, the development of regional cultures, and the related alteration of domesticated animal husbandry practices through time. I document the settlements, settlement patterns, burial practices, and the appearance of the first horse related material culture, the cheekpieces for horse bits. I highlight

that Hungary in the EBA was a bridgehead for the dispersal of horses and bits for the Bronze Age with a regional comparison of the relative frequencies of horses and bits at settlements throughout the region.

In Chapter 4, I undertake the second half of the chronology, cultures, and contexts for this study in the MBA through the LBA. I demonstrate that there was no intrusive chariot package with weapons and aristocratic warriors that introduced the development of MBA sociopolitical complexity. Rather it was a continuation of traditions initiated in the EBA which afforded increased sedentism, population growth, a growth in the number of settlements and their size, fine craft and metallurgical production, large formal cemeteries, and the long lived, relatively peaceful tell building communities. Horses allowed increased travel and trade at great distances, but it is hard to tie their use to any one group. There was a continued intra-regional and extra-regional heterogeneity of horse and animal husbandry at the tell settlements. I document the shifts in the animal husbandry regimes of the periods by site, with attention paid to their orientation for secondary products and commodities, and highlight the variation of these practices throughout Hungary. I then show how horses shifted into politics and warfare in the end of the LBA and into the Early Iron Age. At this time horses were buried with people and weapons, and their appearance on the battlefield is confirmed by c. 1250 BC.

The next three chapters are the more directly analytical portions of the dissertation. They are broadly organized around three areas of study: 1) Production, Exchange, and Selective Breeding of Horses (Chapter 5); 2) Thinking About Horses (Chapter 6); and 3) Using Horses (Chapters 6, 7 and 8). In Chapter 5, I present zooarchaeological data that supports that local, indigenous horse husbandry was in place by the EBA and then spread throughout Hungary in the

MBA. I establish that there were enough horses for use for herding and travel and for some surplus produced for exchange, which was greater in the EBA and less in the MBA and LBA. I also demonstrate conclusively that horses were large enough to ride through comparative biometric quantification of their bones. This data also indicates that people likely selectively bred for greater height and increased refinement increased through the Bronze Age. Variety in horse breeding and use is evident as some people relied on horses more extensively and bred them locally with some exchange, while some eastern groups imported adult horses for use and did not maintain full breeding populations. Strontium isotope analysis confirms the exchange of horses suggested from their mortality profiles.

In Chapter 6, I demonstrate that people thought about horses differently than the other domesticates from further zooarchaeological analysis of body part representation, cut marks, depositional patterns, and horse bone tools. The way people thought about horses was related to the increased use of horses to ride first and then fight from later. From the EBA through the MBA this is evident from the ways in which people used and treated horses when and after they died. By the terminal LBA and into the Iron Age, this importance shifts again to one of a new intimacy and reliance as horses began regularly appearing in human burials and on battlefields. This is coincident with an explosion of artifacts decorated with horses, absent from previous periods. I illustrate through material culture study, that the earliest material culture related to horses, the cheekpieces for bridle bits, and were an autochthonous development unique to Hungary associated with riding. I establish that chariotry was not of any consequence in the Hungarian Bronze Age when the material evidence, décor, and chronologies formerly used to establish its intrusion are

incorrect. Moreover, this data rather substantiates that there was no such ‘chariot package’ which tied horses to warriors and weapons and ostentatious burials in the Hungarian Bronze Age.

In Chapter 7, I provide further evidence that horses were used for riding through an analysis of their teeth and bones. The paeolopathologies on horse teeth and bones from the Hungarian Bronze Age are more consistent with ridden horses than driven horses. Finally, in Chapter 8, I document demonstrably through bioarchaeological analysis, that people were riding horses in the MBA. Riding was widespread, and that it was not restricted by class or sex or tied to warfare.

I present the synthesis and conclusions of this dissertation in Chapter 9 to illustrate how ordinary people, with and through horses, brought the development of the complex societies of the Hungarian Bronze Age. Equestrianism came early in the Bronze Age; the politicalization of horses came later. Horses mounted the genomic transformation of Europe, the breeding and dispersal of domesticated horses into and then from central Europe, and the establishment and spread of tell building cultures. I would argue now that horses also helped people to resist centralized rule, and that resistance with horses to rule became a central tenant of human-horse relationships through time. Some people need horses to rule, and others resist rule with horses. The dismounting of the elite male warrior ruler from his chariot for the Hungarian Bronze Age is in line with recent critiques of earlier grand narratives of the European Bronze Age. The results here support a new and emerging grand narrative which recognizes the labors of local, ordinary people in inciting the cultural changes seen in the development of the complex polities of Bronze age Hungary.

CHAPTER 2

Theoretical Framework

For this dissertation, I evaluate the suspected shifts in human and horse relationships of the Hungarian Bronze Age in the context of large, long-term changes of human and horse co-evolution over time. I use the political economy approach (Earle 2002, 2011; Earle and Kristiansen 2010; Earle et al. 2015; Kristiansen and Earle 2015) to specifically investigate the role of human-horse interactions that may have led to the organization of complex regional polities with institutionalized social stratification ruled by a potentially equestrian warrior elite. This theoretical orientation has been employed to evaluate the organization of Bronze Age societies in Hungary (Duffy 2010; Duffy 2015; Nicodemus 2014; O'Shea and Nicodemus 2017; Polanyi 2018; Quinn 2017; Quinn and Ciugudean 2018; Uhnér 2012) from which my project originates (Earle and Kristiansen 2010). The political economy approach produces testable hypotheses to structure this dissertation research that are specifically related to expectations of animals in the political economy (Arbuckle 2012, 2014a, 2014b; deFrance 2009; Nicodemus 2014).

I place the Hungarian Bronze Age as part of a period of larger transitions of human-horse relationships that have spanned many millennia. In this larger perspective, I draw on research of domestication (Anthony and Brown 2000; Bendrey 2012; Benecke and von den Driesch 2003; Bökönyi 1974; Bökönyi 1988; Kuijt 2009; Levine 1999; Levine et al. 2003; Olsen 2003; Olsen et al. 2006; Outram et al. 2009, 2011; Vigne 2011; Zeder 2012, 2015, 2016, 2017), the secondary products revolution (Anthony and Brown 2011; Greenfield et al. 1988; Greenfield 2010; Marciniak 2011; Sherratt 1981; Sherratt 1983), human genetics (Allentoft et al. 2015; de Barros Damgaard et al. 2018; Goldberg et al. 2017; Haak et al. 2015; Olalde et al. 2017; 2018) and equine genetics

(Achilli et al. 2012; Cieslak et al. 2010; Gaunitz et al. 2018; Librado et al. 2016; Librado et al. 2017; Orlando 2018; Warmuth et al. 2011, 2012; Wutke et al. 2018) to broadly contextualize the changes I suspect happened during the Bronze Age.

I situate human-horse relationships within a multispecies or social zooarchaeology (Argent 2010; 2012; 2016; Armstrong Oma 2006; 2010; 2013; Armstrong Oma and Birke 2013; Brittain and Overton 2013; Boyd 2017; 2018; Marciniak 2005; 2011; Orton 2010; Overton and Hamilakis 2013; Overton and Taylor 2018; Pilaar Birch 2018; Russell 2011; Weismantel 2015), which draws from larger conversation of multispecies ethnography in anthropology, animal studies, posthumanist philosophy, and ontological perspectivism (Anderson 1997; Descola and Palsson 1996; Haraway 2008; 2016; Kirksey 2015; Kirksey and Helmreich 2010; Kohn 2007; 2013; Nadasdy 2007; Noske 1997; Ogden, Hall, and Tanita 2013; Tsing 2015; van Dooren, Kirksey, and Münster 2016; Viveros de Castro 1998; 2012; Willerslev 2007). The Hungarian Bronze Age, and what I expect to be a growing politicalization of human-horse relationships, is oriented in an accumulative continuum of the co-evolution of humans and horses through broad shifts in the character of these associations. This orientation allows me to locate the results of my research into wider dialogues in anthropological archaeology.

Horses in Grand Narratives of the European Bronze Age and in Grander Narratives of Human-Horse Relationships

The political economy model fits within a larger (often called Grand) Narrative of Bronze Age Europe. Articulated most forcefully in Kristiansen and Larsson (2005), Earle and Kristiansen (2010) and Kristiansen and Earle (2015), this has been recently revisited with new studies of human population genomics of Bronze Age Eurasia (Allentoft et al. 2015, in which Kristiansen

was a major author). In this narrative, horses are trotted out to facilitate two larger and key transitions of the Bronze Age: 1) the migrations of Yamnaya peoples and their genomic (and probably linguistic) transformation of Eurasia, and 2) the formation of complex polities by chariot-riding, elite warrior aristocracies from Eurasia to the Near East, Aegean, and Anatolia.

In this theory of long-term change from the end of the Neolithic through the Bronze Age, Earle and Kristiansen (2010:16–18) first place transformative importance on the influx of the Yamanya peoples from the Pontic-Caspian steppes c. 3300 BC into Central Europe (discussed in detail in Chapter 3). The Yamanya movements into Hungary are now well attested by genetic (Allentoft et al. 2015; Haak et al. 2015; Goldberg et al. 2017) and archaeological evidence (Frînculeasa et al. 2015; Gerling et al. 2012a, 2012b; Heyd 2014; 2017). Earle and Kristiansen (2010:20) tie the appearance of the Yamanaya to the formation of Bronze Age political economies because their novel form of mobile pastoralism altered notions of family, property, and inheritance. Particularly, they suggest that the monogamous extended family was the primary economic and social unit in which mobile wealth was acquired and accumulated through trade networks and exogamy, and wealth was transmitted across generations. What is important to highlight, was that the new form of Yamanya pastoralism and migration was made possible by the domestication and subsequent utilization of the ridden horse to manage herds. This is documented from 3500 BC at Botai in Kazakhstan but likely occurring much earlier, along with the expansion of the use of wheeled vehicles (Anthony 2007; Gaunitz et al. 2018; Outram et al. 2009). The spread of domesticated horses west accompanied the Yamnaya migrations.

Secondly, thirteen hundred years later, the rise of Middle Bronze Age societies in Central Europe (c. 2000-1800 BC) has been considered to be part of an international expansion in chariot-

riding warrior aristocracies (Earle and Kristiansen 2010:232–233; Kristiansen and Earle 2015:240–241). “The 2nd millennium BC saw the intensification and expansion of networks created during the 3rd millennium BC by new technologies of mobility, such as chariots, and by the full-scale adaptation of bronze, leading to a more complex political economy” (Allentoft et al. 2015:Supplement p. 6). The first chariot burials were found in the Sintashta Culture of the Trans-Urals (Bochkarev, Buzhilova, et al. 2010; 2010; Chechushkov 2013; Chechushkov, Epimakhov, and Bersenev 2018; Chechushkov and Yepimakhov 2010; Jones-Bley 2000; 2006; Kuznetsov 2006; Pinheiro 2011). In fact, the chariot burials, and purported similar chariot cheeckpieces (detailed in Chapter 6), are used to link recent results of genetic research to archaeological finds that illustrate the expansion of a chariot riding warrior elite.

> In Figure 1 (main text) we have documented the early use of chariots by black dots during the period 2000 – 1800 BC, each dot represents a chariot burial with horse cheek pieces of a similar type. We can thus document the new expanding warrior elites from east Central Europe to the South-Eastern Urals, but also including Mycenae and Hittite Anatolia. A new class of master artisans emerged to build chariots, breed and train horses, produce new weapons and train others in using them. This package of skills was so complex that it demanded the transfer of people, horses and warriors to be properly adopted. Once adopted this package changed the nature of society, as it introduced a whole series of new economic and social demands, as well as a new ideology of aristocracy linked to warfare and political leadership. Thus, it represented a new institution of warrior aristocracies and their attached specialists that changed Bronze Age societies throughout Eurasia and the Near East (Allentoft et al. 2015:Supplement p. 5).

The above proposed milestones in human history were made possible by and because of shifts in horse-human relationships, one c. 3300 BC and another c. 2000 BC. The political economy model of Bronze Age Hungary is embedded in these shifts in which horses underlie all the changes. Novel uses of horses ushered in the socioeconomic changes of family, property, and inheritance in the Copper Age / EBA transition and the complex political economy that characterized the Bronze Age. In this sense, horses would have become increasingly politicized in

their uses and social significance. By politicized, I mean that horses became inextricable from the political pursuit of power, and that their use, ownership, and cultural provenance would be increasingly tied to institutions of rule and social hierarchy through time, especially including use in warfare.

Horse-based warfare has been pinpointed as a major factor in the evolution of complex societies in the Old World to explain where and when the largest-scale complex societies arose (Turchin et al. 2013). The scale, size, and degree of inequalities of Old World complex societies has also been explained as related to and beginning from horse-mounted warfare. Kohler et al. (2017:619) contend,

> that the generally higher wealth disparities identified in post-Neolithic Eurasia were initially due to the greater availability of large mammals that could be domesticated, because they allowed more profitable agricultural extensification, and also eventually led to the development of a mounted warrior elite able to expand polities (political units that cohere via identity, ability to mobilize resources, or governance) to the sizes that were not possible in North America and Mesoamerica before the arrival of the Europeans.

The process though which the human-horse relationship is increasingly politicized and directed towards warfare is suggested to have begun in Early Bronze Age Eurasia. Moreover, the differential distribution of large-bodied domesticated animals and the incorporation of horses into political economies and warfare are viewed as a significant multiplier of human polity building. Turchin et al. (2013:16388) argue “the diffusion of horse-related military technologies from the steppe-sown interface results in a characteristic spatiotemporal pattern of spread of intense forms of warfare, leading to macrostate forms of political organization”. Increasingly conscribed horse ownership and use have been deeply implicated in the growth of high socioeconomic disparities and in the development of empires. Horses become tethered to wealth, power, and polity building in the European Bronze Age. Kohler et al. (2017:621) find,

> Shortly after Δ3000 many Eurasian societies developed bronze metallurgy and horse-mounted warfare. The emergence of a new mounted warrior elite contributed directly to higher Gini coefficients [a proxy for house-size distributions] given their large rich houses and indirectly through territorial conquests that greatly increased polity scale. Horses and pack animals (including camels in some areas) were potent offensive weapons allowing successful polities to expand further than was possible in the Old World than the New World.

The Political Economy Approach

To begin, “The political economy is the material flow of goods and labor through a society, channeled to create wealth and to finance institutions of rule” (Earle 2002:1). Quite simply, people who wish to lead need ways to procure food, land, material goods, and support from others so that they may govern. “The chief comes to power because of his or her ability to access, centrally control and manipulate elemental power through his personalized chieftaincy of supporters. Political strategies rely on an emergent political economy. All complex societies, both chiefdoms and states, required finance grounded in their economies” (Earle 2011:32). There are two related aspects in the development of a political economy: 1) essential powers of central rule, and 2) new structures of rule. The intertwined powers of central rule are derived from the economy, warrior might, and ideology. Economic power is based on the ability to accrue, then give or deny, food, housing, protection, or material goods to the population. Furthermore, leaders give these same goods and usually special restricted goods to their supporters to reward them for their fidelity and also to identify them, thereby increasing difference and instituting social stratification.

In this political economy approach, staple finance and wealth finance are two sources of economic revenue from which aspiring leaders draw, variously used together to seize, establish, and maintain power (D’Altroy and Earle 1985; Earle 1987). Staple finance is procured from the

subsistence economy, and includes livestock, their primary (carcass) and secondary products (dairy, traction, wool), and the produce of crop production. Wealth finance is procured from manufacturing and obtaining special goods from craft specialists within the polity or through the exchange of goods produced within the polity for goods not locally availably via external trading partners. Both types of finance require some specialization in agricultural production or craft manufacture to produce a surplus above the producers' subsistence needs that leaders may use for their endeavors.

Warrior might is necessary to developing political economies to assure that the governed produce and supply the appropriate surplus goods to feed into the coffers of those who govern. Warriors also protect the rulers, trade, and the polity itself and exercise control of land. As a new structure of rule, a more permanent warrior class develops into a new institution with the growth of the political economy. Special training, weapons, and appearance usually define a 'warrior elite'. Ideological power is the third cornerstone of centralized rule, where rulers must provide a narrative for compliance by their followers and their consequent support that is religiously sanctified. Religious institutions and their religious leaders are established to provide additional institutional legitimization for the ruler or rulers' actions. These intertwined powers of central rule, along with new institutions formed to support and enable them, engender institutionalized social stratification, whereby a largely agrarian population of commoners and craft producers supports an elite class of warriors and leaders. Leadership becomes hereditary and sanctioned by an ideology, materialized in the landscape and by material culture, that ensures its reproduction.

Earle (2002, 2011), Earle and Kristiansen (2010), Earle et al. (2015), Kristiansen and Earle (2015) view the political economy as a defining characteristic of the Bronze Age of the Europe,

whereby people who aspired to rule "come to power in their ability to exert rule laterally over many formally independent groups" (Earle 2011:34). This results in the formation of complex regional polities, sometimes explicitly characterized as chiefdoms (Earle 2011) or chiefdom-like polities (Kristiansen and Earle 2015). Complex regional polities are generally defined by a radical scalar increase in size, centrality, and complexity of organization. Emergent hierarchy and complexity of socioeconomic and settlement organization are suggested to further delineate Bronze Age societies from the Neolithic qualitatively. Contingent upon the shifting character of the political economy from staple to wealth finance, "The shift from the Neolithic to the Bronze Age was a profound structural transformation based on a changing political economy" (Earle et al. 2015:634). This qualitative shift is posited to stem from "developing prestige goods exchanges and commodity trade in metal that caused significant institutional (qualitative) restructuring to facilitate such regular trade" (Kristiansen and Earle 2015:235–236).

First and foremost, Kristiansen and Earle (2015), Earle and Kristiansen (2010), and Earle et al. (2015) envision a fundamental reorganization of Bronze Age societies centered on land-based, staple finance in the Neolithic to trade-based, wealth finance in the international flow of metals in the Bronze Age. Concurrent to this, they see ownership or control changing from an emphasis on agricultural land to an emphasis on trade routes. The nature of property relations shifted from local corporate ownership of productive lands to leaders individualizing and exerting control over lands and goods essential for trade. The desire for metal is put forth as the main reason for the Bronze Age shift. They find "all Bronze Age communities were dependent on metal for their social identity, warrior weaponry, and basic subsistence economy from the Middle Bronze

Age onwards" (Kristiansen and Earle 2015:239). Copper and tin ores needed for metal production were not local to Hungary, so trade was required to import them.

However, the subsistence economy was still necessary to provide local export commodities for copper and tin. For the Hungarian Bronze Age, Earle and Kristiansen (2010) and Kristiansen and Earle (2015) see staple finance both directed to provide a surplus of food for supporters and also reoriented into surplus production of secondary animal products to support the emergent wealth finance oriented political economy. Leaders required a surplus of specialized animal export products, including primarily wool and textiles (but also potentially horses) to exchange for the ores. Control of the agricultural lands and their off-take remained a priority for products of agricultural surplus for the warrior aristocracy.

A central emphasis is placed on comparative advantages of regional variations in land, location, and natural resources (such as ores). Goods produced and their associated commodity chains, were constricted by bottlenecks (Earle et al. 2015:639):

> A commodity chain involves the linkages among resource extraction, processing, fabrication, transportation, exchange, and consumption for a particular product…Bottlenecks are constriction points in commodity chains, which offer the opportunity to limit access by creating ownership over resources, technologies, or knowledge.

Bottlenecks to the flow of metals are suggested to be fundamental in the development Bronze Age political economies. The position of fortified tells established in Hungary directly on the Danube River is given as evidence for the desire to control the flow of metals, exemplified by the small-scale chiefdom of the Benta Valley, centered on the Százhaomobatta-Földvár tell right on the Danube (Earle and Kristiansen 2010; Earle et al. 2015). The Benta Valley polity not only had positional advantage to provide a bottleneck for the flow of metals on the Danube, it may have had

a comparative advantage in agro-pastoral products from its associated settlements, documented by an apparent reorientation of animal production to wool in sheep and dairy and traction in cattle (Vretemark 2010).

Warriors were critical to bottlenecks, as they were needed to extract payment for safe passage. They subsequently controlled the ownership and distribution of metals and their ideologically charged character. In this view, a warrior elite or warrior aristocracy, their associated ideologies and technologies, developed as the new social institutions that were established as structures of rule. They emerged in efforts to secure surplus local production in desired agricultural products, control and facilitate long-distance trade, and to legitimize and stabilize the asserted rule. "This ability to control economic flows in both subsistence and wealth depended on the creation of social institutions with specific cultural formations most importantly involving property rights and the formation of a new type of warrior aristocracy/institution to protect them" (Kristiansen and Earle 2015:238–239).

Animals in a Political Economy Model

That the metal trade was a prime mover in the developments thought to characterize the European Bronze Age, including centralized polities, increased social stratification, and urbanization is an old and influential idea (Childe 1929, 1930, 1936). Similarly, a second major and equally significant theory regarding these same changes is specifically related to domesticated livestock including horses. After the Neolithic Revolution proposed by Childe (1936), where domesticated animals afforded people control over the economy through control over the food supply, the Secondary Products Revolution (SPR) (Sherratt 1981, 1983, 1997) enabled people to

further exploit living domesticated animals for additional purposes. In this, the shift from utilizing livestock for their primary or carcass products (meat, marrow, hide, bone, sinew) to their secondary products (dairy, wool, traction, riding) precipitated the widespread changes listed above that ushered in the Bronze Age in the Old World.

> Almost thirty years ago, Andrew Sherratt (1981, 1983) presented his Secondary Products Revolution model to explain the dramatic changes in economic (subsistence, settlement and trade) and political organization that swept across the Near East and Europe during the Chalcolithic and Early Bronze Age (EBA). These are periods of dramatic change when the earliest states and chiefdoms appear in the Near East and Europe, respectively. This grand model proposed that these dramatic changes were the result of innovations in the nature of domestic animal production and related technologies. These innovations led to a revolution in food production, mobility, local and inter-regional exchange and settlement patterns. Sherratt drew upon the previously recognized distinction between primary and secondary animal products to account for these changes (Greenfield 2010:29–30).

The timing of when the SPR occurred for each species has been reevaluated, as the secondary products of many animals were utilized early in the domestication process, especially with horses for whom domestication may have been motivated by their use for traction and milk (Greenfield 2010; Marciniak 2011). However, the idea that secondary products provide an ideal, controllable form of wealth and an animate expression of social status and ideological power has had considerable staying power. In the political economy approach, the coupling of metal trade and livestock commodities to explain the Hungarian Bronze Age sequence combines the two earlier theoretical traditions. In collusion with the metal trade, a reorientation of animal production to secondary products has been suggested to be a principal component in the emergent political economies (Earle and Kristiansen 2010; Kristiansen and Earle 2015; Vretemark 2010).

Recent research incorporating the ideas of secondary products, the rise of complex societies, and the political economy has provided testable hypotheses for understanding

domesticated animals in Bronze Age societies. With animals in the political economy specifically, deFrance (2009:105–106) explains,

> The rise of inequality was accompanied by pervasive and fundamental restructuring of the relationship between humans and animals. Complex societies possessed hereditary inequality as well as multiple scales of hierarchy and rank (Marcus and Flannery 1996; Rosenswig 2000; Spencer 1993). Zooarchaeological remains can be used to understand how animals functioned in various realms and at different scales to provide food, to create commodities that denoted status, and to serve as ideological symbols of power.

Generally, when speaking about animals in the political economy, they are primarily seen as a mechanism by which people accumulate wealth, differentiate status, leverage control over others, or to increase and supplement economic specialization, either through their trade as commodities or as food for craftspeople and laborers engaged in non-food production. Identity and status thus become materialized, or more precisely they are animated, through ownership, control, or use of certain animals and they become part of an institutionalized ideology in the political economy. Moreover, deFrance (deFrance 2009:108) finds that, "Centralized control and elite involvement with animal production is greatest when animals provide secondary products". When animals can be harnessed to produce both valuable commodities and serve as living expressions of political economic control, they become intimately tied to pursuits of power.

Animals have been used to accumulate wealth and difference, probably early in domestication processes. Makarewicz (2013:170), describing the southern Levantine Late Pre-Pottery Neolithic B (Late PPNB, 9250-8700 cal BC) found, "These societies developed pastoralist mechanisms for creating wealth that lay at the heart of the emerging structures of increasingly stratified societies that emerged well before the appearance of proto-urban and state-level societies". Surplus production of livestock and livestock products are considered to be central to identity and social stratification from the Neolithic Near East outwards and onwards. However,

the shifts identified in secondary product production in the Copper (Chalcolithic) and Bronze Ages are thought to be more directly related to the development of non-state complex societies in Eurasia, though animals certainly factor in political economies in other regions of the world and in states (deFrance 2009).

Increased elite control over livestock and a focus on their secondary products has been linked to the emergence of complex, hierarchical pre-state societies in Anatolia from the Chalcolithic (6000-3000 BC) and Bronze Age (2900-1200 BC) (Arbuckle 2012; 2014a; 2014b). Arbuckle (2012:311) first demonstrates that a reorganization of sheep management from subsistence-level production to the production and commoditization of wool was part of the foundational structure of wealth and power disparities that arose in Late Chalcolithic (Copper Age) Anatolian communities:

> As a result of the fact that animals are ubiquitous sources of wealth and the processes of producing, distributing and consuming them are fundamentally reflective of social inequalities (at a variety of scales) it can be suggested that faunal remains provide a unique window into the nature of the rise of early complex social systems. Since animal economies may have been one of the fundamental tools used by aspiring elites to expand and reify inequalities, detailed and socially contextualized studies of systems of animal exploitation provide a productive way to explore the early states of the development of social inequalities.

Explicitly, he finds “the emergence of wool-exploiting economies seems to be intimately linked with the rise of persistent and significant social inequalities” (Arbuckle 2014a:220). Wool production and woolen textiles, termed the ‘wool horizon’, were of central importance to elite rule and the rise of inequalities in the fourth millennium BC from central Anatolia and Mesopotamia, to the Pontic-Caspian steppes to Eastern Europe. This reorientation to the secondary products of sheep and goats suggests the commodity production of wool was coincident with the rise of social

complexity including a three-tiered settlement hierarchy, small centers with public architecture, and the development of local manufacturing industries.

Arbuckle (2014b) then explores the central role of domesticated cattle and their secondary products as sources of elite wealth and status in the rise of increasingly complex, hierarchical, and competitive societies in Bronze Age Anatolia. Accordingly, he lists a number of useful correlates to test the roles of animals in the political economy including a significant increase in the number of the cattle in the faunal assemblage, an association between settlement centers and the highest frequencies of their remains, and ties between elites, oxen, and oxen-drawn wheeled vehicles expressed through cattle sacrifice and mortuary rituals in which buried pairs of oxen are placed with chiefly elites. Frequencies of cattle in faunal assemblages are used as a proxy to track the spread of social stratification and complex polity formation through Bronze Age Anatolia.

Horses in the Political Economy of Bronze Age Hungary

Nicodemus (2014) presents a robust and invaluable model for the role of horses in the emergent political economies of Bronze Age Hungary through a thorough study of animal production, consumption, and distribution including horses and other domesticated fauna, crop agriculture, craft production, and regional exchange at the contemporaneous (and likely regionally connected) tell of Pecica-*Şanţul Mare* in Romania. Not only is this research rare because it specifically examines the role of horses in the political economic framework, it does so from a close by and perhaps similarly conceived polity. Nicodemus also helpfully compares the animal production strategies at the tell site of Pecica to its related off tell sites and to the polity centered

at Százhalombatta-Földvár in the Benta Valley, Hungary and other tell centered polities of the period.

At the central tell of Pecica-*Şanţul Mare*, the numbers of horses in the faunal assemblage rises considerably and the political economy unfolds, from <5% in the Early Period (EBA/MBA transition 2000-1850 cal BC) to nearly 30 % in Phase 4 of the Florescent Period of the MBA (1850-1770 cal BC), the highest proportion of horses found at a tell site in the Carpathian Basin (Chapter 5). The numbers also subsequently decline significantly by the Late Period (1720-1600 cal BC), back to around 5% and more horses were maintained into old age, 8% Florescent MBA to 25% Late Period MBA. There are specialized deposits ('bone piles') of high quality, meaty portions of prime-aged mares on the tell. The cut-marks and deposition indicate a significant probability that these are the remains of feasting. The demographic profiles (age/mortality profiles) may indicate a population of horses likely geared for export, given the shear number and since many prime aged animals are missing.

Finds of three cheekpieces for bits indicate use for riding or traction. Although Nicodemus (2014) strongly asserts early evidence of chariotry present at Pecica-*Şanţul Mare*, the finds to support this assertion are limited to one or perhaps two small fragements of clay model spoke-wheels that could represent a chariot or may be spindle whorls. Biometric or osteopathological data is not included in this dissertation, so it is hard to say if horses were selected for size or shape as a more regularized commodity or if their teeth had evidence for bit wear or the bones for particular types of use, be it ridden or maybe pulling a chariot. What is abundantly clear, however, is that the particular and intensive husbandry and likely export of horses precluded the intensive production and trade in metals, which was present in the period just after peak horse production.

Pecica-*Şanţul Mare* represents a case where intensive horse production probably provided the bottleneck needed for elites to gain control of metallurgical production and trade. That horses initially provided the fulcrum for a developing political economy is of note. When horse breeding was at its highest, other animal management practices were geared towards specialized meat production and distribution, maybe provisioning the central tell. Key findings related to political economic development and increased social stratification include the high numbers of horses increasing through time as the tell expands, concentration of horses at the tell, probable regional exchange of horses, and the unique deposits of horse remains as evidence for feasting. Furthermore, the horses of Pecica-*Şanţul Mare* illustrate likely elite control and management as well as the increased ideological significance of horses to elites to legitimize and reinforce their rule. The horse management system represents a case of how horses could be co-opted by elites and used as a principal component of an emergent political economy.

In the political economy model for the Hungarian Bronze Age in the Benta Valley, the role of human-horse relationships in its development has not been explicitly demonstrated, but general assumptions have been made as to their importance. These assumptions highlight an influx and spread of horses, trade in horses as a commodity, and the advent of new horse-based technologies, especially chariots and bits. Subsequently, horses are seen as mounting the development of elite warrior aristocracies in the Benta and beyond. Horses are thus placed at the heart of the political economy, at the intersections of transport and control of trade, warfare, warrior institutions, and ideologies. Linkages between regions that are assumed to underline emergent political economies in many places of the European Bronze Age are placed on the backs of horses.

Earle and Kristiansen (2010:20) suggest horses and chariotry arrived as a package from the east and that the whole warrior institution centered on this transformed the Bronze Age of the Old World:

> Master artisans came to build chariots, breed and train horses, and produce and train warriors in the use of new weapons. The packages of skills were so complicated that it must have demanded, at first, the transfer of artisans, horses, and warriors. The warrior aristocracies and their attached specialists transformed Bronze Age societies throughout Eurasia and the Near East.

Moreover, horses are considered to be paramount in religion, as new gods appear to have "symbolized horses and chariots and their role in warfare as well as in carrying the sun" (ibid).

They find that the unquenchable desire for metals spurred innovations in maritime land transport technologies, including the chariot. The introduction of the chariot required horses, craftsmen, and warriors for trade expeditions. Chariots are listed as a marketable product for trade and horses are suspected to have been produced in a specialized breeding operation geared as an export commodity (Earle and Kristiansen 2010:225, 240; Earle et al. 2015:246; Kristiansen and Earle 2015:240–241). Further evidence is given for trade and alliance networks of a warrior aristocracy, and the institutions of a warrior elite, established in the emergent political economy in Bronze Age Hungary based on a rather free interpretation of what the author's term "The Charioteer's House" at Százhalombatta-Földvár (Earle and Kristiansen 2010:232–233).

> In Hungary, within the defended core of the tell settlement at Százhalombatta, sat a cluster of houses overlooking the Danube. In largest excavated house there, a huge pot contained two pairs of decorated antler cheekpieces covered with a fat brownish substance.
>
> We interpret these to have been part of a full-horse harness of leather, with only the antler cheekpieces for the bits fully preserved. Such gear is special, the type used to harness the horses, which perhaps drew a chariot. The use of antler is also specific for the Carpathians (Kristiansen and Larsson 2005:figure 79), but with some also reaching Scandinavia (Thrane 1999)… We imagine this house as that of either a warrior or charioteer, members of a new warrior elite in the MBA cultures of Hungary.

> These were a class of new military specialists, undoubtedly charged with protecting their people and overseeing an emergent trade economy along the Danube that stretched out on the river below. Chariots and charioteers brought new skills in horse dressage as well as new construction techniques for chariots. Also, simple roads had to be maintained between settlements. In Denmark, the linear distribution of barrows suggests the existence of trackways between local polities over land, where ships could not be used.
>
> The new elite warriors employed the long-sword and shared with the early Mycenaean culture not only chariots, but also the characteristic boar tusk helmets. The early helmet form consisted of separate leather bands onto which rectangular pieces of carved out boar tusks. This early form is well described in the Illiad (Illiad Book 9:260-72) and is preserved in a shaft grave from Aegina from the 18th century BC (Kilian-Dirlmeier 1997). Identical pieces were found in a grave from Nižná Myšl'a in the Carpathians (Hughes-Brock 2005:figure 5), but they are also known from tell sites in Hungary and Rumania (Bronzezeit in Ungarn 1992:abbildung 88; Kasco 2004:plate XLI:1). From here, well-bred horses may have been exported south, where horse breeding was difficult, and these horses appear in the graves of Mycenae. Warrior elites created long-distance connections that channeled not only amber from Scandinavia and horses from the Carpathians to the south, but ideas and institutions of warrior elites and weapons were carried back north. Because much of this was immaterial or of organic material (textiles, chariots, boar-tusk helmets) it is not easily discerned today, and swords and other warrior equipment were soon manufactured to local standards. However, we may detect such institutions in the appearance of a package of objects, for example, for weaving (Barber 1991:303–310); in the use of specific ritual paraphernalia, such as clay figurines (Biehl 2008) or in the material indications for the chariot and its derived institutional support, from rock-art pictures in Scandinavia to cheek pieces in the Carpathians and the east Mediterranean (David 2007; Harding 2007).

This passage lays out the central arguments regarding horses in Bronze Age Europe and in the Hungarian Bronze Age political economy model as envisioned by Earle and Kristiansen (2010), Earle et al. (2015), and Kristiansen and Earle (2015). International trade in metals and the related increase in long-distance mobility of the European Bronze Age were predicated on the development of boat and horse based technologies, and especially in their opinion, the chariot. Breeding of horses became important with the metal trade and the chariot. Intensifying warfare was also thought to necessitate chariot technology. Earle and Kristiansen (2010:241) suggest that

specialists attached to leaders, which became a new social class, were necessary to breed and train horses and warriors, and to construct chariots. They assert that,

> the chariot throughout Eurasia came to symbolize a new speedy transport for warfare that had long-term historical consequences for the breeding of horses for transport (Kelekna 2009). These technological revolutions expanded the potential for long-distance mobility and interaction on a systematic basis from the beginning of the Bronze Age, and by combining sea and land-based journeys new regions could suddenly be connected. The volume of trade expanded both scope of commodity transport and the demands for specialists to take care of travels – including shipbuilding and navigating at sea, and the construction of wagons and training of horses for land transport. New specialized social groups, with a new institutional framework to support them, emerged, and at the same time such specialists expanded the cognitive geographies of Bronze Age communities tenfold or more.

In terms of material culture, the bit cheekpieces are incredibly important in establishing if chariotry did in fact arrive to Hungary in the Bronze Age, and to demonstrate how horses were used. The décor on some cheekpieces is viewed as an identifier of the institutionalized warrior aristocracy that they believe came to dominate all of Euraisa (Earle and Kristiansen 2010:239):

> In Hungary, full-hilted decorated swords formed a category of their own, often deposited with decorated ritual axes (Hansen 2005). The decoration was likewise charged with symbolic and cosmological meaning (Jockenhövel 2005). A related decoration is found on horse bits and antler cheekpieces for horses, which define an even larger elite horizon stretching from the Urals to the Carpathians…. Also, in Hungary and in the wider region of the Carpathians, we find a linkage between a ruling warrior elite and a specific decoration loaded with ritual and cosmological significance, and during the MBA they probably defined an overriding ethnic elite identity in the Carpathians.

Kristiansen and Earle (2015:240) add, “By adding weapons and horses to the cultural inventory, a warrior elite apparently arose as a dominant social segment”, moreover, “the position of the tells and the addition of status defining wealth and weapons demonstrate a fundamental institutional (qualitative) transformation in Bronze Age society from its predecessors in Hungary and beyond”. Horses then were absolutely primary in this model for the development of complex Bronze Age societies and institutionalized social stratification.

Hypotheses for Horses in the Political Economy Model of Bronze Age Hungary

Taken together, the assumptions regarding horses and the political economy of Bronze Age Hungary and the above studies from Hungary and other regions demonstrate how domesticated animals may be engaged in the development of complex societies, political economies, and the rise of social stratification. They provide a number of testable correlations for this study, listed below, as well as places to look for the evidence of these correlations.

Animals important to the political economy should show:

1) An increase in number during its development

- An increase in the relative abundance of the taxa in the faunal assemblage

2) An accompanying cultural shift in their ideological significance

- An increase in related material culture
- Specialized deposits of animals in ritual sacrifice, human burials, or feasting
- Iconography of or relating to animal on material culture

3) Clear ties to elite control, usage, and ideology

- Social differentiation in ownership and use of particular animals present in a select or small percentage of households, human burials, related material culture
- Circumscribed consumption of carcass products, like better cuts of meat or tools made from bone
- Preferential food consumption or different regimes of work related to animals in human remains

4) Concentration at the central settlements where their primary and secondary products were procured, distributed, and exchanged

- Relative abundance of taxa largely conscribed to central places and missing from supporting settlements
- Certain age classes or sexes preferentially found at central settlements and missing from surrounding settlements or regional specialization

5) Husbandry practices should demonstrate an orientation to secondary products with concomitant production of surplus animals their related products

- Mortality profiles
- Herd composition
- Body part representation
- Butchering practices
- Production technologies like spindle whorls for weaving

6) Entrance into the sphere of commodity exchange with evidence of their subsequent commoditization

- Biometric changes in size, robusticity, or variation

7) Evidence of their exchange

- Mortality profiles that show concentrations of age classes geared for export or import when livestock is exchanged on the hoof
- Isotopic evidence of exchange in their teeth and/or bones

Broadly, if specific domesticated animals were important to the development of political economies in the Hungarian Bronze Age, they should show an increase in their percentage of the

faunal assemblage, increased ideological importance, ties to elites and social differentiation by class and gender, concentration at central settlements, secondary products orientation with specialized production of commodity products for exchange, and evidence of these animals in exchange systems. With horses in the Hungarian Bronze, there should be evidence for how horses were used, and specifically used by elite warriors, through the bit cheekpieces, bit-wear on horse teeth, osteological pathologies of horse and rider or charioteer, and by chariot or chariot related finds. Equestrianism should emerge as an institution whereby horses, the ownership, control, use, and exchange were clearly linked to the warrior aristocracy. Warfare and ideological correlates to the elite warrior institution, such as the décor on the bits and weapons, should further substantiate if horses were important to political economies and the suggested rise of warrior aristocracies throughout Eurasia. Equestrianism should emerge as an institution with the development Bronze Age political economies.

Human-Horse Relationships in a Multispecies Perspective

The results are further examined in light of what has been variously termed social zooarchaeology or multispecies archaeology (Argent 2010; 2012; 2016; Armstrong Oma 2006; 2010; 2013; Armstrong Oma and Birke 2013; Brittain and Overton 2013; Boyd 2017; 2018; Marciniak 2005; 2011; Orton 2010; Overton and Hamilakis 2013; Overton and Taylor 2018; Pilaar Birch 2018; Russell 2011; Weismantel 2015). Employing this perspective is important examine the political economy model with respect to animals and situate human-horse relationships in time. In concert with broader dialogues of the ‘animal turn’ in the social sciences and in contemporary anthropology of a multispecies anthropology and ethnography (Anderson 1997; Descola and

Palsson 1996; Haraway 2008; 2016; Kirksey 2015; Kirksey and Helmreich 2010; Kohn 2007; 2013; Nadasdy 2007; Noske 1997; Ogden, Hall, and Tanita 2013; Tsing 2015; van Dooren, Kirksey, and Münster 2016; Viveros de Castro 1998; 2012; Willerslev 2007), Pilaar Birch (2018:6) suggests archaeologists should consider "…the most essential linchpin in the study of the past: the multi-specific nature of major transformational periods in an inclusive, shared history of life".

A social zooarchaeology and multispecies archaeology both aim to work past a solely anthropocentric understanding of the past and to de-center humans in this story in order to provide a greater understanding of the complex entanglements that people have with animals, plants, material culture, and their environments. Overton and Hamilakis (2013:111) advocate moving beyond thinking of animals as economic, nutritional, or symbolic resources for people to meet their goals, to positioning animals as sentient, agentic individuals where both humans and animals are mutually constituted. This position somewhat complicates the presence of animals in the political economic model, where they primarily reside as part of subsistence or where they may be incorporated into transactions of staple or wealth finance to support the political economy. Their symbolic importance has not been overlooked, but animals, including horses, are viewed as rather passive or static resources that people use as pawns in political and social machinations.

Instead, incorporating the agency recently given to things and artifacts, human-animal engagements should be seen 'mutual becomings' (Birke et al. 2004:174; also Armstrong Oma 2006; 2010) because animals "have the power and ability to elicit responses from people, including emotive responses, and engage in communicative relationships" (Overton and Hamilakis 2013:114). As a result, they participate in social relationships with people and shape and direct human behavior with their individual and species-specific behaviors. Prehistory is co-constructed

with animals (and plants, fungi, water, bacteria, etc.) and is thus co-evolutionary. From human DNA, to mobility, movement, labor, material culture, and phenomenology, this corporeal and active exchange, through often asymmetrical and problematic, and its consequences has left the evidence that archaeologists uncover when examining animal and human bones, material culture, and the contexts of interaction, such as the landscape, environment, buildings, farms, settlements, roads, pastures and beyond.

Placing the political economy model and its expectations of human-horse relationships within a multispecies framework also presents a rather troubling reality of what contribution anthropological archaeology and grand narratives of the Bronze Age may be making to the "modernist project", unintended or otherwise. Boyd (2017:305–306) explains,

> At the heart of these evolutionary narratives sits the inherently anthropocentric nature/culture dualism. For more than three decades, "beyond nature/culture" has been a recurring motif in archaeological/anthropological discourse (initially, e.g., Descola and Palsson 1996; MacCormack and Strathern 1980) Despite this critique, the nature/culture dichotomy has proven tenacious in contemporary archaeological approaches to animal domestication… Masculine human control of wild nature is key here… As Fowles has argued, in discussing the human/nonhuman relation as one of "our existing great divides" (quoted in Alberti et al. 2011:906), archaeologists' "major contribution [to the modernist project] has been the evolutionary ontostory of how the modern liberal humanist subject has come to be and of how the world of nonhumans has been drawn increasingly into his (the gendering is necessary) sphere of control".

So deliberately at first, and more inadvertently now, the Bronze Age has become another rung on an ever-increasing androcentric and elite narrative of mastery over nature, women, animals, commoners, and continents which begins with the Neolithic Revolution and continues with the Secondary Products Revolution and Urbanization.

A multispecies archaeology perspective troubles both the grand narrative of the Bronze Age and the grander narratives of human-horse relationships. As I see four great shifts in human-

horse entanglements that result in new forms of interspecies sociality, the way that these processes unfolded must be considered from a horse perspective and a perspective that the horse also harnessed the human. That these changes allow humans to do different things because of these ‘mutual becomings’ does not necessarily (or even probably) mean that it was because people had attained a greater mastery over horses or improved equitation. New forms of interspecies sociality imply that people and horses ‘got on together’ differently as they also altered and were altered by their lived contexts. Taking seriously the idea that human interactions with domesticated animals are fundamentally constrained by the nature and needs of the species and individuals with which they interact, certain things are also made possible, such as the Yamnaya migrations into central Europe and mounted warfare.

However, the tempo and direction of such innovations were also largely directed by what horses and other domesticated animals need and how they think and behave. Human competition over lands on which to graze their livestock, herded on horseback, is widely thought to have led to the Yamnaya migrations (Anthony 2007). Environmental degradation, or at least some significant loss of pasturelands, may have also led to increased conflict among people as populations dispersed, aggregated, and clashed in the LBA and later (French 2010). The domesticated livestock’s needs of a certain amount of pasture and access to water lies at the very heart of these periods of change in human prehistory. That people may have considered livestock property or that it was human desire that led people to move or fight over land must be considered in light that these choices were both constrained and enabled by domesticated livestock and by the contexts in which they lived with each other. Whose needs and wants drove whom? There is an important multispecies dialectic (multi-lectic?) to consider when framing all changes in human prehistory.

People are living in a horse (and other non-human) *habitus* and vice versa. Human agency is always embedded in a co-inhabited and co-created world.

Turning anthropocentric views of horse domestication and use around may help us to see beyond the strangely, and lingering materialist and techno-determinist ideas about human-animal co-history making. How much of human success and evolutionary selection was based on the decisions and needs of horses? In very simple terms, the genomic transformation of Europe by mounted peoples and human life, death, and reproductive success may have been at least predicated on the decisions of horses, especially when mounted warfare is considered. Distances between settlements and exchange patterns had to be given much consideration to ridden possibilities. Daily and seasonal rhythms of horse and animal husbandry, its labor, and equestrian training regimes were driven by the many quirks of a herd of individual animals and their reproductive cycles. Human decisions about travel and migration were always in genuflection to the needs and natures, possibilities and constraints of horses and other domesticated animals. The co-evolutionary, co-constructed history of our combined species placed in this perspective can help to direct the formation of new theory and sensitive, integrative research. In the synthesis and conclusions (Chapter 9), I offer some preliminary thoughts on what this might entail.

CHAPTER 3

Chronology, Cultures, and Contexts Part One: Sustenace to Herding and Travel, The Domestication, Introduction, and Spread of Horses into Hungary through the Early Bronze Age

Horses and humans have a truly ancient co-specific history; the history of humans has been inextricably intertwined horses through many millennia. I conceive of the co-evolution of horses and humans through four general phases of time: *sustenance* (33000-5000 BC); *herding and travel* (5000 BC-2000 BC); *politics and warfare* (2000 BC to 1900 AD); and recently *sport and leisure* (1900 AD-present) after the end of the World War I. In this chapter, I introduce the co-evolutionary phases of human-horse relationships as they develop through sustenance, domestication, and into herding and travel. Riding domesticated horses, people were able to travel great distances with large herds of livestock. They arrived into the Carpathian Basin in the Copper Age with people who had new cultural traditions and ways of life based in animal husbandry. I show that indigenous equestrianism and horse husbandry were then well established and characterized the settlements of the EBA. Contextualized by the environmental characteristics, I document this influx of people and horses, their regional cultural contexts, and the related alteration of domesticated animal husbandry practices through time which afforded increased population density, settlement size, and number. I highlight that Hungary in the EBA was a bridgehead for the dispersal of horses and bits for the Bronze Age.

Sustenance

The first evidence of human-horse interactions is found during the Upper Paleolithic (c. 33000 – 10000 BC) throughout the Old and New World when people were hunters and horses

were prey (Olsen 1989, 1996, 2014). Neanderthals, early modern humans, and anatomically modern humans all had quite close predator-prey relationships with horses (Levine 1999a; Levine et al. 2003; Benecke and von den Driesch 2003). Arguably, people have known horses since the origins of our species. Remarkably realistic horses were among the earliest known paintings people made in a number of European caves from 33000 BC – 10000 BC, and represented about 30% of animals illustrated (Pruvost et al. 2011). The genotypes of these horses matched their phenotypes painted; the paintings depicted horses how they looked in real life. The meanings of the paintings are debatable, but clearly horses fed people both literally as evidenced by butchered horse bones on archaeological sites, and spiritually as evidenced by their early artistic representation (Bendrey 2012; Clutton-Brock 1992; Guthrie 2006; West 2006). The appearance of horse in art and diet indicates a special kind of relationship between people and horses germinated in the Upper Paleolithic (Olsen 1989, 1996). From early on, horses were important to how people were able to eat and survive, and as such, they helped to influence how, where, and when people moved, how they related to one another, and how people conceived of the world.

Domestication

“The horse was domesticated…thousands of years after dogs, cattle, pigs, sheep, and goats. The horse nonetheless represents the domestic animal that most impacted human history” (Librado et al. 2016:423). Domestication is a process, best defined currently as,

> a sustained multigenerational, mutualistic relationship in which one group of organisms assumes a significant degree of influence over the reproduction and care of another group to secure a more predictable supply of a resource of interest and through which the partner organisms gains advantage over individuals that remain outside this relationship, thereby benefitting and often increasing the fitness of both the domesticator and the target domesticate (Zeder 2015:3191).

Distinguishing domestication now focuses on identifying the genetic, phenotypic, plastic, and contextual (natural or cultural) process and markers that can be used to trace it regarding the target species (Zeder 2006; Zeder et al. 2006).

All of the animals at the core of Bronze Age economies were domesticated millennia earlier than horses, but also, like horses, had much longer entanglements with people for millennia prior to their domestication. Dogs (by 13000 BC archaeologically, 40000-30000 BC genetically) were the first to be domesticated in Eurasia (MacHugh et al. 2017). Sheep (9000 BC), goats (8500 BC), cattle (8300 BC), and pigs (8300 BC) followed and were all domesticated prior to horses in the Near East in the Upper Euphrates Basin (Fuller 2006; Larson and Fuller 2014; Larson et al. 2014). Major plants including barley (8000 BC), emmer (8200 BC) and einkorn wheat (8600 BC), lentil, pea, chickpea, bitter vetch, flax, and millet were also domesticated in the early Holocene (Fuller 2006; Weiss and Zohary 2011; Zohary and Hopf 2001). Agriculture and animal husbandry spread up the Danube into the Carpathian Basin from the Near East to Anatolia via the Balkans by 5500 BC with the Linear Pottery Culture (Dolukhanov et al. 2005; Hofmanová et al. 2016; Price et al. 2001). The spread of agriculture occurred with a migration of peoples who intermingled with resident hunter-gatherers (Allentoft et al. 2015; Gamba et al. 2014; Haak et al. 2015). The first large tell settlements sprung up in Neolithic Hungary after the arrival of agriculture inhabited by groups of closely related farmers that had arrived from Anatolia (Parkinson et al. 2004; Yerkes et al. 2009).

As with dogs, pinpointing the origins of the domesticated horse has been a much less easy task than it was for the other domesticates. Paleogenomics, divergent skeletal morphology, and archaeological contexts have converged neatly for the other ungulate species to pretty clearly

discern timing and place of origin. Recent paleogenomic analyses of horses offered good results about where domesticated horses originated, but have been vaguer about when because of the different process by which horses were domesticated compared to another species (Gaunitz et al. 2018; Librado et al. 2016). The western part of the Eurasian steppes has been identified as the probable location of domestication (Warmuth et al. 2012). But because many wild female horses (mares) were continually bred to few domesticated male horses (stallions) over several millennia, the physical differences from wild horses are non-existent, and it obscures the timing.

> [T]he domestication of wild horses was a process that involved only closely related male horses but allowed for more variation in the female lineages. Archaeological evidence dates horse domestication no earlier than the Eneolithic period (6-7 kya). Therefore our data indicate that multiple female horse lines were domesticated…the most recent common female ancestor of all modern horses lived ~140 kya and many haplogroups underwent domestication since the Eneolithic period in multiple Eurasian locations (Achilli et al. 2012:2452–2453).

Because domesticated horses are not skeletally different from their wild progenitors, even quite difficult to distinguish between other equids, and because horse hunters were likely horse domesticators, their presence on archaeological sites has been hard to disentangle. Archaeological indicators of horse domestication have included: 1) changes in the skeleton and teeth related to work and human-directed care, 2) shifts in the age and sex of culls, 3) the presence of horse manure in corrals on human settlements, 4) the presence of mare's milk residues in pottery, 5) shifts in geographic distribution outside of the Eurasian steppes, 6) archaeological sites with artifacts depicting horses or that of horse tack (namely bits), and 7) changes in human behavior patterns thought to be only correlated to domesticated horses, including the presence of horses in human burials that are treated like other domesticated animals (Anthony and Brown 2011).

Archaeologically, it has now been widely accepted that horses were domesticated by 3500 BC *at the latest* in Kazakhstan based on metric analyses of horse metacarpals that are similar to domesticated ones in Bronze Age Hungary, pathological characteristics that indicate some horses were bridled and probably ridden, and organic residue analysis that reveal processing of mare's milk and carcass products in pottery (Outram et al. 2009). The genetic and archaeological data indicate this process is much older. Anthony and Brown (2011:137) have made a substantial argument horse domestication occurred nearly two millennia prior, between 5300 and 4800 BC, as an outcome of cattle and sheep husbandry strategies on the western steppes of Eurasia. The earliest stages of horse management led to their subsequent domestication. "Management is "the manipulation of the conditions of growth of an organism, or the environment that sustains it, in order to increase its relative abundance and predictability and to reduce the time and energy required to harvest it" (Zeder 2015:3192).

Anthony and Brown (2011) contend that the first people that thought seriously about the benefits of keeping, feeding, and raising the *managed* horses that would become domesticated were stockbreeders and farmers who were thoroughly familiar with other domesticated ungulates and with wild horses on the Pontic Caspian Steppes. As regular horse hunters, they were experts of equine behavior and could exploit that to their benefit. Horse domestication occurred while people were still hunting wild horses while subsisting on domesticated herds of cattle, sheep, and goats, herded with the help of dogs. This diet was supplemented with domesticated crops and by hunting and fishing.

Horses are easier to feed through the winter than cattle or sheep because they paw through the snow to graze in the winter, whereas cattle do not, and require warmer, snow-free pastures or

hay in the winter (Anthony 2007:200–201). Horse herds may have first been managed for the sake of cattle, and may have continued to play an important role for cattle management in the Bronze Age of temperate, and snow-covered in winter, Europe. Horses actually clear the snow for cattle to be able to graze, a process seen today on lands in the United States where domesticated cattle follow wild (feral) mustang herds (Evans et al. 1994; Ryden 2005). People who lived in cold grasslands with domesticated cattle and sheep would have seen the advantage in keeping horses, if just for clearing snow and a supply of winter-season meat. More than 50% of the animal bones from a number of cattle focused herder sites around 5300 BC on the Pontic Caspian steppes are of horse bones (Anthony 2007). There is an increased reliance on horses at this time.

Between 4800 BC – 4500 BC, the earliest evidence of domesticated horses in human graves comes as head and hoof offerings from the western steppes at Khavalynsk and S'yezzhe on the Middle Volga River and Nikol'skoe on Dneiper River. A head and hoof offering is the placement of the animal's skull and metapodials (lower legs and hooves) into graves, probably with the hide still attached (Figure 3.1). Horses were treated like other domesticated animals as ritual head and hoof sacrifices in human graves and their images were carved on bone plaques (Anthony and Brown 2011:138).

> Certainly horses were linked symbolically with humans and the cultured world of domesticated animals by 4800 BC. Horse-keeping would have added yet another element to the burst of economic, ritual, decorative, and political innovations that swept across the western steppes with the initial spread of stockbreeding at 5200-4800 BC (Anthony 2007:201).

The adoption of domesticated horses had rather immediate social effects as herd sizes of other animals increased with the help of mounted herders and asymmetries between kin-based groups of herders grew. A pedestrian herder with a dog can manage 200 sheep; a mounted herder

with a dog can manage 500 (Anthony and Brown 2011). Anthony (2007:160–161) sees the spread of horse assisted animal husbandry here as concurrent with incipient social stratification and leadership. Some people were buried with increasingly fancy possessions and jewelry in quite large tumuli burials with indications of feasting and many head and hoof animal sacrifices.

Figure 3.1. Author's Interpretation of a Horse Head and Hoof Offering Prior to Burial.

The Early Copper Age: 4500/4400 BC – 4000 BC

At roughly the same time in the Carpathian Basin, the Early Copper Age (ECA) arrived with the Lengyel III and Tiszapolgár cultures. I use the term *cultures* in this dissertation following Hungarian archaeologists' designations of them based on similarities in regional occupation, settlement practices, material culture, and burial rites (Visy 2003). In the ECA, there was an

opening up of grasslands in northern Hungary and marshes on the lower Danube Valley suitable for grazing as the climate cooled (French 2010). The location and environment of the Carpathian Basin has everything to do with settlement patterns and its early genesis of equestrianism. Hungary is situated on some of Europe's richest loess soils and lies at the juncture of natural trade routes connected by the Danube. The distribution of loess in Europe clearly shows its singular abundance in the Carpathian Basin, highlighted in green (Figures 3.2 and 3.3.). Most of the country is suitable or very suitable for agriculture (Figure 3.4).

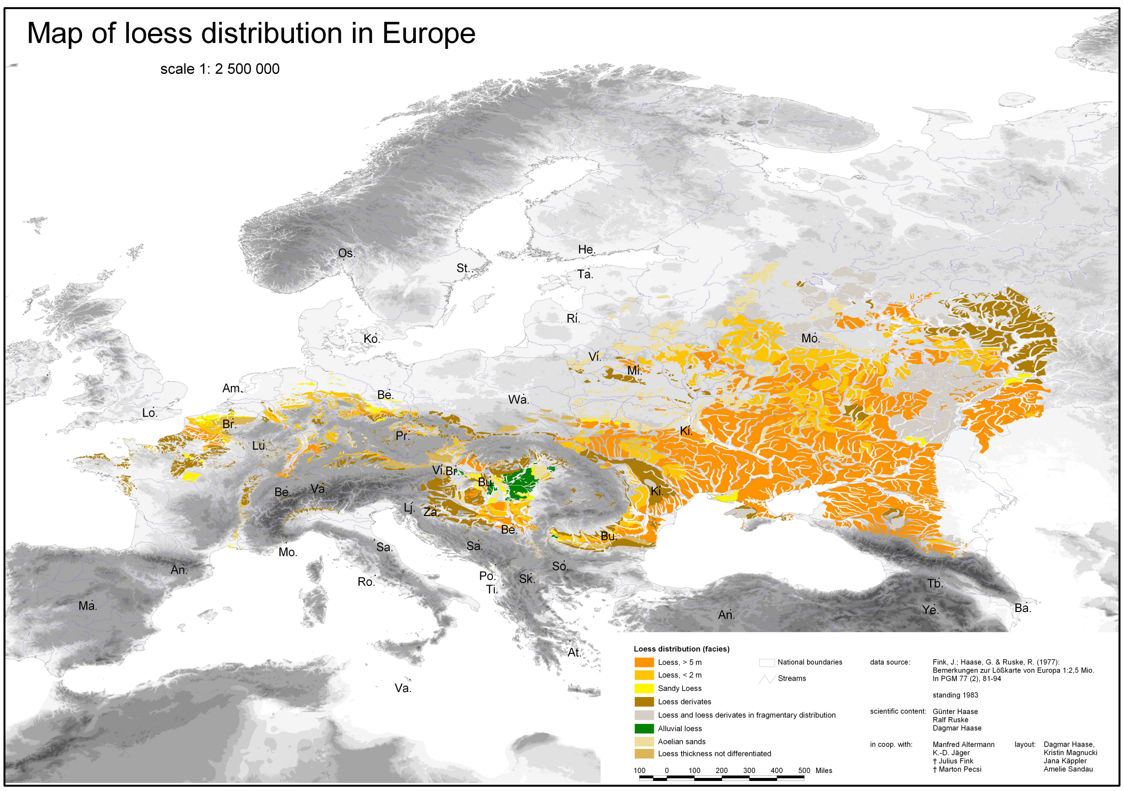

Figure 3.2. Loess Distribution in Europe (Haase et al. 2007). Note Green in Hungary.

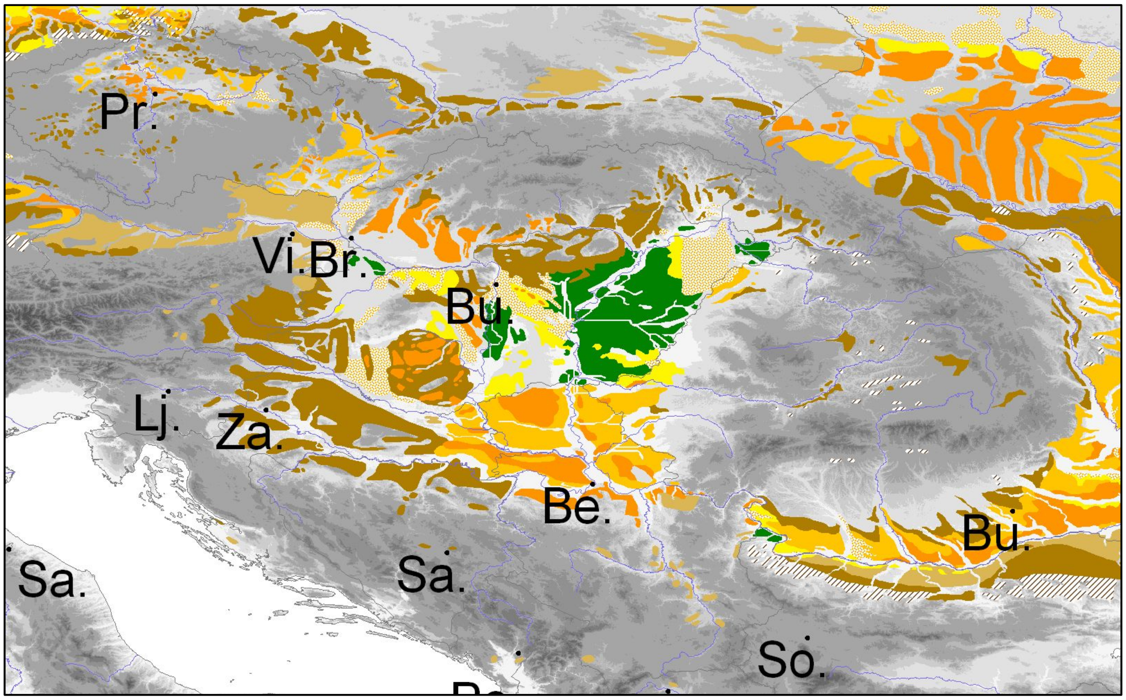

Figure 3.3. Enlargement of Loess Distribution in Hungary.

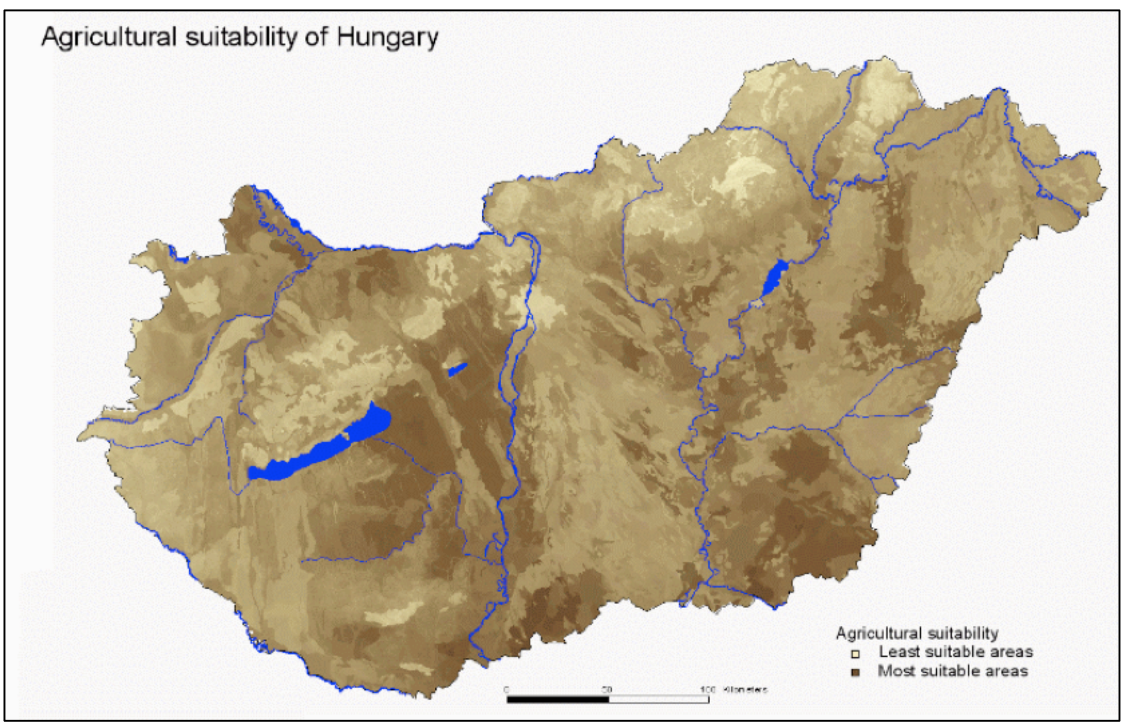

Figure 3.4. Agricultural suitability of Hungary (Ángyán et al. 2013).

Protected by the mineral rich ring of the Carpathian Mountains, this land contains the first well-watered and high quality pastureland west of the more arid and less nutritionally dense grasslands of the Eurasian steppes. This pastureland provides more nutrition per hectare, can withstand a higher stocking rate (number of animals per hectare), and has easy and abundant access to water (Gardiner and Miller 2007; Pearson and Ison 1997). It can support a more intensive, sedentary type of animal husbandry generally, and horse husbandry specifically, compared to the extensive nomadic pastoralism or seasonal transhumance required by steppe grasslands, meaning more livestock can be kept on less lands with less movement (Allen et al. 2007; Archer 1980; Bott et al. 2013; Evans 1995; Evans and McKendrick 2010; NRCS 1989; Singer et al. 1999; Sollenberger et al. 2012). These dense, warmer, and wetter pasturelands became available during the end of the Atlantic climatic period across Europe c. 4200-3800 BC (Sümegi et al. 2002).

As the grasslands increased, the closely packed network of smaller settlements in the Tiszapolgár culture of the ECA spread (Horváth and Virág 2003). These peoples kept large herds of domesticated livestock, but apparently diverged on a preference of cattle versus sheep and goat (ovacaprids), and had rather substantial numbers of swine and a few dogs (Figure 3.5) (Bökönyi 1974). At this time, domesticated horses first appeared in Hungary. The site of Deszk contained a decorated horse metacarpal (Bökönyi 1959). At the sites of Tiszapolgár culture settlements of Kisköre-Szingehát, Kenderes-Telekhalom, Kenderes-Kulis horse bones were also present (Bökönyi 1971, 1974), illustrated in Figure 3.6.

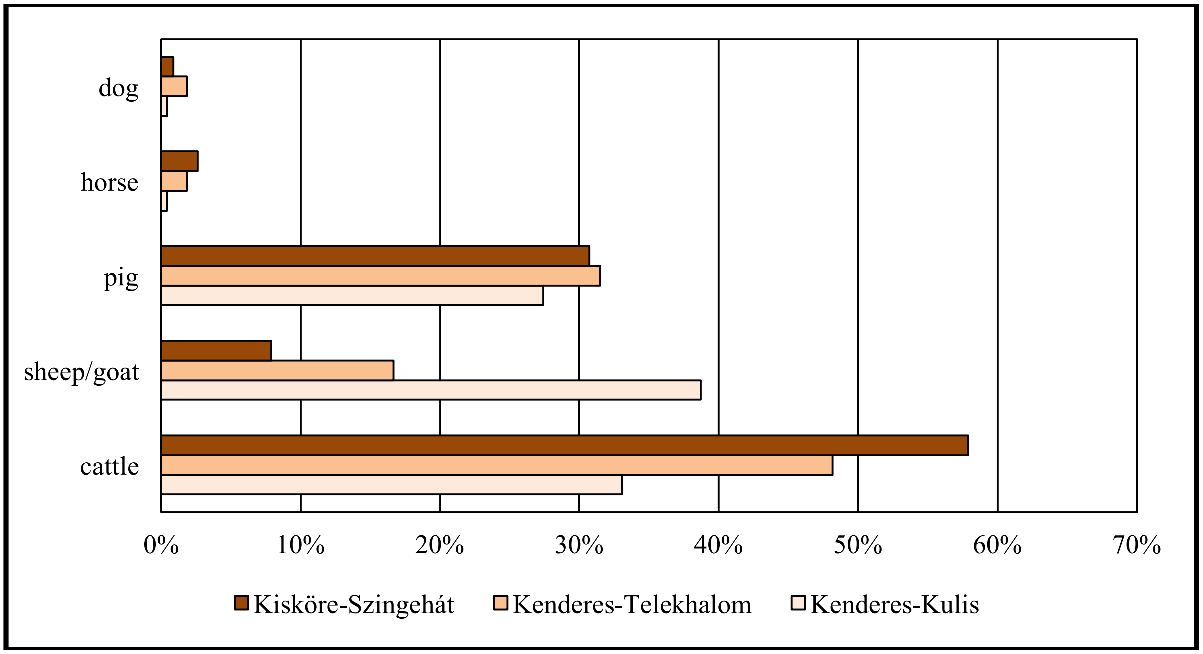

Figure 3.5. ECA Domesticated Animals in NISP %.

In the lower Danube valley, specialized artifacts depicting horses were also found: maces in the shape of horses. The presence of these maces and horse bones accompanies the advance of riders into the Carpathian Basin. Anthony (2007:254) asserts riding likely began before 4200 BC, "The horse head maces signaled a new iconic status for the horse…If horses were not being ridden into the Danube Valley, it is difficult to explain their sudden symbolic importance in old European settlements". Between 4300 – 4000 BC, 3-6% of the *Number of Identified Specimens (NISP)* was of horse bones at sites in the lower Danube Valley at Tripolye B1 and Gumelniţa culture sites, and horses do not appear important in diet (Anthony 2007:254). Horse head maces, elite objects that originate in the steppes at 5000 BC, also were present at these sites (Anthony 2007:211).

Figure 3.5 depicts the relative abundance of domesticated taxa in the faunal assemblage as the percentage of the Number of Identified Specimens (NISP) in the faunal assemblage. This measure of relative frequency is the simplest measure of taxonomic abundance of animal species,

and the one that is most commonly used (von den Driesch 1976; Reitz and Wing 2008). In this dissertation, all published reports of faunal remains and previously excavated horse bones found within the Carpathian Basin use this measure of relative abundance. Zooarchaeologists use NISP as the basis for estimating the *Minimum Number of Individuals* (MNI) which some reports also contain. Both of these measures can be used to assess relative representation of different species or groups of species from archaeological sites. While these measures of relative abundance can have inherent biases (Peres 2010), because Bökönyi (1959; 1968; 1974; 1978) and his students Choyke and Bartosiewicz (1999, 2000) provided all of the analyses at the seventy-four sites I used to compile information about horse husbandry from the Copper to the Iron Age in the Carpathian Basin, there is a strong degree of continuity in methods and interpretation. They also based their analyses on sites where the animal bone samples were over 500 specimens (Bökönyi 1971).

Maps of relative horse abundance that are given throughout text this use the Index of *Horse Relative to Cattle* (HRC) as shown in Figure 3.6 and map hereafter. Bendrey (2007a:220) outlines this particularly useful method of quantifying horse remains that I use to better document the presence of horses for every period. Because cattle and horses have a similar-sized skeleton, taxonomic processes that occur through time similarly affect them at the same site. Since cattle and horse skeletons will have similar amounts of preservation, they will be recovered roughly equally from the archaeological record at the same site. HRC is calculated as a percentage to total NISP of horse and cattle for each assemblage, and is calculated thusly.

Index of horse relative to cattle (HRC) $= NISP_{horse} / (NISP_{cattle} + NISP_{horse}) * 100$

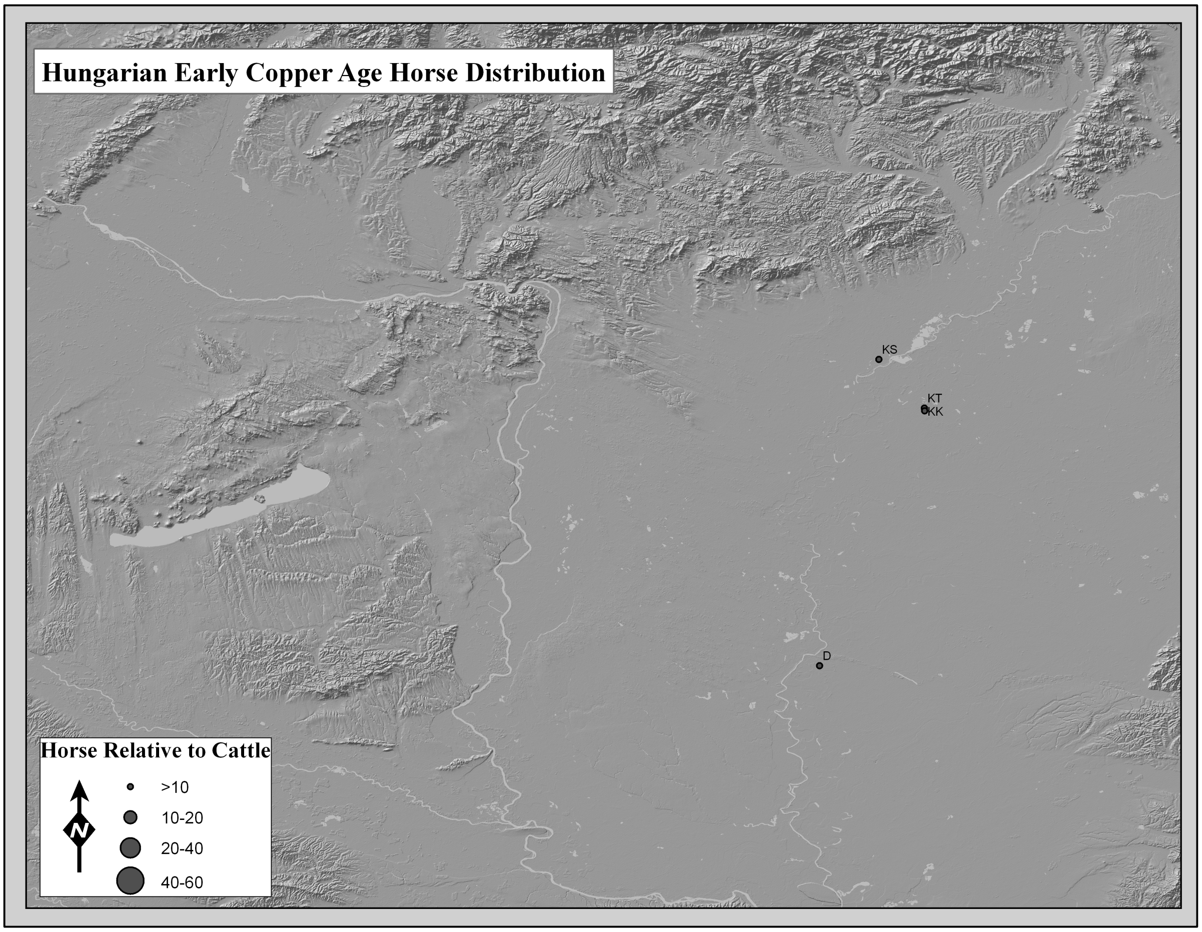

Figure 3.6. Map of ECA Horse Distribution in Hungary, Horse Relative to Cattle (HRC).

A note on the relative abundance of horses from archaeological sites is necessary. Although the importance of horses to past human communities is often discounted because generally fewer bones are recovered from archaeological sites, it must be remembered that horses are generally recovered in the small numbers through time, across cultures, and across societies of increasing sociopolitical complexity that are absolutely reliant on horses, e.g. the Romans, the Scythians, the Huns or almost any horse culture of indigenous North America, save some cultures who are wholly reliant on them, like the peoples at Botai. NISP of horses are almost always much lower number than the NISP of other domesticated taxa. The reasons for this are generally, 1) disposition of

horses at death is regularly different than that of other domesticated taxa and, 2) it does not take as many horses to herd or mount a retinue of warriors as it does other domesticated animals to feed a population. This is detailed fully in Chapter 5 with comparative data from a number of periods in Hungary. HRC is one way to overcome these biases in the archaeological record.

The Middle Copper Age: 4000 – 3600/3500 BC

Continuing into the period of the Middle Copper Age (MCA) in Hungary, the Balaton-Lasinja, Ludanice Bodrogkeresztúr, Stoke Ornamented Pottery, and Hunyadihalom cultures developed differently with variable, increased, and sustained interaction with populations from the east. Large cemeteries on the Great Hungarian Plain indicate that the Tiszapolgár culture became the Bodrogkeresztúr peoples, but the Balaton-Lasinja culture shows more influence from the Balkans and more substantial cultural changes than in eastern Hungary. The Ludanice of the northeast retained a similar character the preceding Lengyel communities.

Extremely fancy gold jewelry and heavy copper axes highlight the Bodrogkeresztúr period as the *floruit* of the Copper Age. At the end of the MCA, the Hunyadihalom culture that succeeds the Bodrogkeresztúr, delimits the arrival of eastern and southeastern peoples. The numbers of settlements and population both decline substantially in this period (Horváth and Virág 2003). Trade between the steppean cultures and the Bodrogkeresztúr and Funnelbeaker (TRB) and a shift to Hungarian/Transylvanian ores evidenced increasing trajectories of contact of this period of significant change.

All the old Tell cultures of Neolithic Hungary were abandoned by 4000 BC (Duffy 2010; Parkinson et al. 2004; Yerkes et al. 2009). The first wheeled vehicles (wagons) and late Proto-

Indo-European (PIE) speakers appeared on the Pontic Caspian steppes at this same time (Anthony 2007; Anthony and Ringe 2015). Developing with the aid mounted herders, the steppe economies were becoming oriented towards a new form of highly mobile pastoralism that was also associated with spread of PIE. There was a full dietary dependence on pastoral products and the striking use of domesticated animals as ritual currency for public sacrifices. Most importantly for this discussion, was the genesis of a nomadic wagon-based equestrian pastoralism, where bulk transport and housing was by wagon and rapid transport and herding occurred by horseback. This revolutionary way of exploiting grazing animals and grasslands was related to the migrations of this mobile pastoral economy into Central Europe. With the decline of the Old European tell cultures, the more crop based agricultural economy declined, and mounted steppe herders pushed into the desirable marsh pastures of the Danube Valley as climate on the steppes became more arid. "This was no massive folk migration but a series of long-distance movements by small groups, exactly the kind of movement expected among horseback riders" (Anthony 2007:256).

MCA peoples of the Tisza region where horses were first found in the ECA became dispersed with the more mobile pastoralism. Fewer settlements have been excavated on the grasslands here but at the site of Magyarhomorog (Bodrogkestúr Culture) an incised (decorated) horse metacarpal was recovered (Bökönyi 1974). Between 3900 BC – 3600 BC, horses were present at lower and middle Danube (Peške 1986). Transhumant pastoralism aided by riding was present in the Balkans by this time (Greenfield 1999). By 3800 BC – 3350 BC, the TRB culture has domesticated horses in the Czech Republic as demonstrated by increased variability in size (Kyselý and Peške 2016). The Maikop culture of the Western Causasus has widespread appearance of horse bones and images (on silver cup and painted on a frieze) and displays evidence of people

riding between 3700 BC – 3100 BC (Chernykh 1992:59). All of these expansions of horses into regions where they were previously extinct during the later fourth millennium BC is a key non-metric indicator of domestication (Anthony and Brown 2011; Zeder 2016).

Back on the steppes in northern Kazakhstan, between 3800 BC – 3700 BC, clearly domesticated horses were present on a large-scale with a horse-centered economy at Botai culture sites of Botai, Krasnyi Yar, Vasilkovka, Roshchinskoe (Olsen 2003; Outram et al. 2009). Horse bones comprise 99% of 300,000 recovered animal bones. Botai peoples probably rode horses to hunt horses, a peculiar adaptation found only here and only between about 3800-3000 BC. The economy of these sedentary animal agriculturalists was based almost exclusively on exploitation of the horse for meat, tools, milk, and traction. The horses at Botai were milked, bitted, and had cannon bones that match the size at the withers (the junction of the neck and back where height is measured in horses) and robusticity (the thickness of the bone) indices for domesticated horses. Scholars have used the aforementioned site of Csepel-Háros as a clear site of domesticated horses in Central Europe. The Botai horses are within the size range of the Csepel-Háros horses.

The most recent genetic research regarding horses has found something rather suprising: while the Botai horses were domesticated, they are not the source for all later domesticated horses.

> That none of the domesticates sampled in the last ~4,000 years descend from the horses first herded at Botai entails another major implication. It suggests that during the 3rd Mill BCE at the latest, another unrelated group of horses became the source of all domestic populations that expanded thereafter. This is compatible with two scenarios. First, Botai-type horses experienced massive introgression capture (22) from a population of wild horses until the Botai ancestry was almost completely replaced. Alternatively, horses were successfully domesticated in a second domestication center and incorporated minute amounts of Botai ancestry during their expansion (Gaunitz et al. 2018:113).

Riding almost certainly accompanied early domestication, but this inference has been unduly contentious, as has placing the earliest *definitive* evidence for riding. What is considered

definitive evidence for riding has been the subject of raging debate, but thorough scientific evidence has come to rest on the side of early riding proponents (Anthony and Brown 2011). While the subject of riding into the Carpathian Basin has been controversial, the place of Hungary as a center of early horse husbandry is much less so. From the western steppes,

> Central Europe is one of the first regions to where domestic horses subsequently diffuse. Fifty years of research in the eastern end of the region, the Carpathian Basin and surrounding uplands, has demonstrated a total lack of evidence for indigenous horse domestication west of the Carpathians. In the Carpathian Basin, the remains of equids are found…on a few Neolithic sites…Subsequent to their domestication, horses spread from eastern to central and southeastern Europe during the Eneolithic (Greenfield 2006:221–222).

The Late Copper Age: 3600/3500 BC – 2800/2700 BC

The Late Copper Age (LCA) of Hungary is known from the Protoboleráz, Boleráz, Baden (Pécel), Vučedol, Kosztolác, and Pit-grave/kurgan cultures. The long-term interactions of Hungarian peoples with steppean cultures from farther east had significant impacts on local cultural developments in the LCA. The Protoboleráz cultural horizon was a time of blending external influences and local traditions (Horváth and Virág 2003). Ultimately, the large and much more uniform Baden cultural complex emerged in this period, in the early phase called the Boleráz horizon. Similar pottery styles, including new drinking vessels, burial customs, and the ostentatious display of weapons and valuables in graves becomes widespread. Heyd (2014) attributes this to the increase of mobility and migration with exogamy, new communication networks and connectivity, and new patterns of exchange. Gerling et al. (2012:1097) find,

> There are clear physical interactions between local and intrusive individuals and population groups…This is where the organized movement of human beings – in one (or many) migratory events – embedded in a range of socially induced strategies based on mobility, herding practices and horsemanship, took place.

The Yamnaya of the Pontic Caspian steppes, with innovations in horse husbandry and cultural organization, have been indicated as perhaps the major force of this dramatic cultural and economic change seen in Copper Age Hungary (Frînculeasa et al. 2015; Harrison and Heyd 2007; Heyd 2014). Growing out of the earlier cultures that domesticated horses, they had a thoroughly developed form of fully nomadic equestrian pastoralism with wagons and vast herds of cattle, sheep, and goats. They have also been identified as the peoples who were speakers of late PIE who spread their language, culture, and genes into the Carpathian Basin and further. Population genetics substantiate this massive migration of Yamnaya peoples from the Pontic Caspian between 3000 BC – 2500 BC (Allentoft et al. 2015; Goldberg et al. 2017; Haak et al. 2015). There are hundreds, maybe thousands, of Yamnaya type kurgan cemeteries in large, spatially coherent clusters in eastern Hungary, north of the Körös River (Ecsedy et al. 1979; Frînculeasa et al. 2015; Gerling et al. 2012; Heyd 2017; Harrison and Heyd 2007; Kaiser and Winger 2015; Sherratt 1997b). This was a context of cultural coexistence and some opposition between immigrant pastoralists and settled Copper Age/EBA Hungarian agriculturalists.

While the Yamnaya spread throughout the Old World, they may have immigrated to the Carpathian Basin for horse-trading, mate acquisition, and land (Anthony and Brown 2017; Anthony and Ringe 2015; Ecsedy 1994; Ecsedy et al. 1979). The beginning of the LCA was the beginning of the Sub-boreal climactic phase, which was warmer and drier than the Atlantic. There was a major clearing of woodland for pasture and a dominance of grasslands for animal husbandry in the Carpathian Basin (French 2010:46; Sümegi and Bodor 2005). This might have been quite a pull for the Yamnaya as pasture quality and abundance was affected as rainfall declined, which may have motivated them to seek better pastures in Hungary (Gerling 2015; Shishlina et al. 2009).

Goldberg et al. (2017) recently found Yamnaya males from Pontic Caspian steppes were migrating into Central Europe with range of 5-14 men for every woman. Along with social institutions that increased long distance trade and interaction, this overabundance of men is consistent with Anthony and Brown's (2017) theories of roaming bands of young men leaving their steppean homeland to locate pasture and suitable female partners as obtaining both became increasingly competitive. The Yamnaya were most probably mounted and riding was one reason for their rapid, substantial, and widespread genetic infiltration of the Carpathian Basin and beyond.

The spread of Indo-European (IE) languages was a central part and process of the Yamnaya expansion. Anthony and Ringe (2015:208) couple the Yamnaya mobile animal husbandry, with its vast herds and increased asymmetries, with new forms of client/patron relationships, divulged in PIE vocabulary. They find the westward spread of IE dialects absolutely related to the sociopolitical adaptations to high mobility and "the maintenance of social life at a distance" (ibid:209), whereby social relations were adapted to occasional meetings and the reputations of the heads of herder lineages were of utmost social concern. Previous iterations of stockbreeders on the Pontic Caspian steppes had cultural institutions that celebrated the collective. Because of the growth-oriented style of Yamnaya animal husbandry, cultural institutions reflect growing social stratification. A hierarchy of rich versus poor was expressed through dress, body decoration, and weaponry and advertised through impressive feasting and funerals. Feasting became the vector for an unequal mobilization of labor and resources by self-aggrandizing individuals as rivals competed publically through enormous feasts and funerals. Long distance trade and constant contact with outsiders was stimulated by the need for exotic and valuable gifts to give to allies and made possible by their equestrianism. Political recruitment through alliance building was key to

developing reputation, wealth, and power and was confirmed by gift giving and oaths of loyalty. PIE vocabulary contains clues to the institutions that fed growing stratification with its lexemes of appropriate gift giving and receiving, host-guest relations, and centrality of feasts with animal sacrifice to honor gods and to secure property. The LCA Yamnaya animal based economic, social, and political practices seem foundational for the development of complex regional polities and the institutionalization of social stratification that has come to characterize the Bronze Age.

The spread of the Yamnaya is clearly seen in LCA Hungary with the increased presence of horses, wagons, large sheep, and new burial practices. The LCA Kétegyháza – Cernavoda III/Boleráz Group (Baden/Boleráz Horizon) of the Pit-Grave/Kurgan culture have horses, large (probably wool) sheep, and drinking cups in their kurgan burials in southeast Hungary, which are clearly related to steppean kurgan burials (Bökönyi 1974, 1978; Ecsedy et al. 1979). Horses also are located at settlements on the Danube bend near Budapest and around Lake Balaton. The earliest known wagon finds come from 3500 – 3300 BC, demonstrated by wagon models at Budakalász and Szigetszentmárton. There was a double cattle burial with possible cart and man and woman buried at Budakalász and a wagon was illustrated on a clay cup in Poland (Horváth and Virág 2003). The scratch plow (ard) and cattle traction clearly arrived in Europe by the LCA (Sherratt 1983). Animal husbandry in the LCA was focused on either cattle or ovacaprids with less numbers of swine, which reflects the nature of this more mobile pastoralism (Figures 3.7 and 3.8).

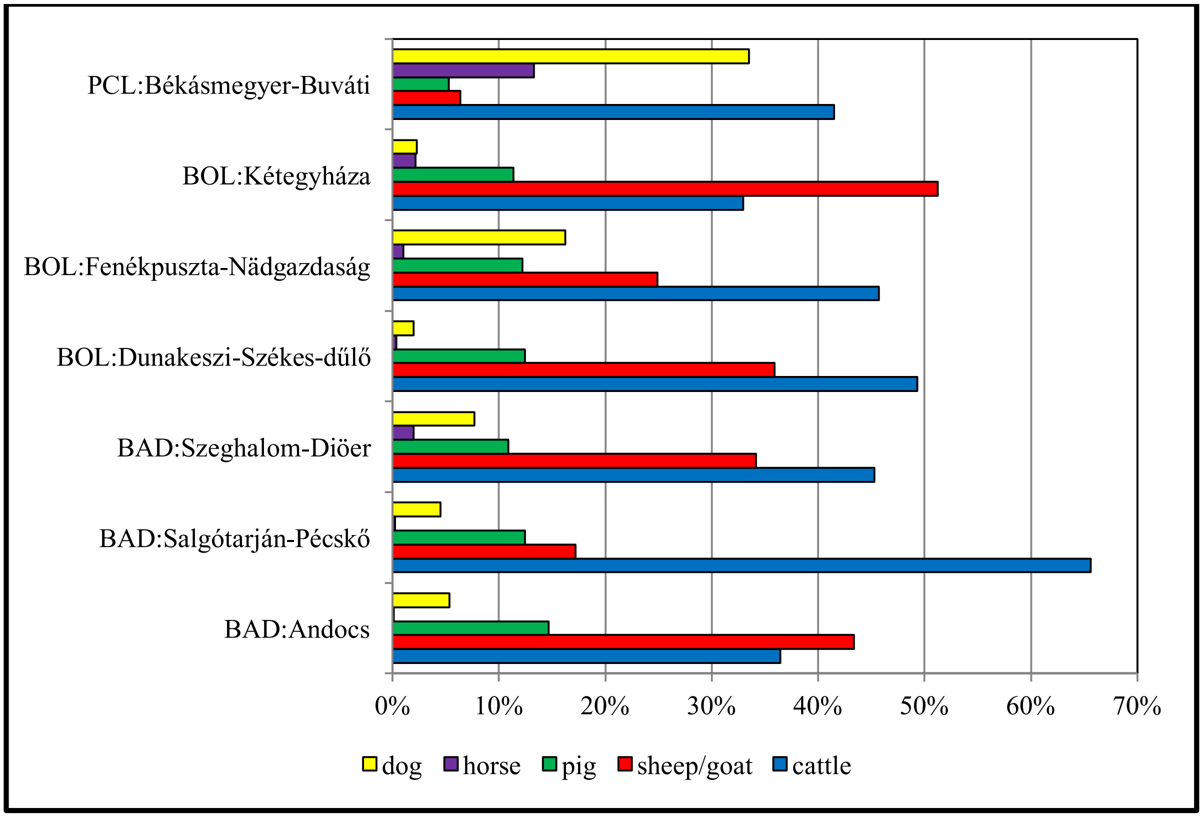

Figure 3.7. LCA Relative Frequencies of Domesticated Animals in NISP %.

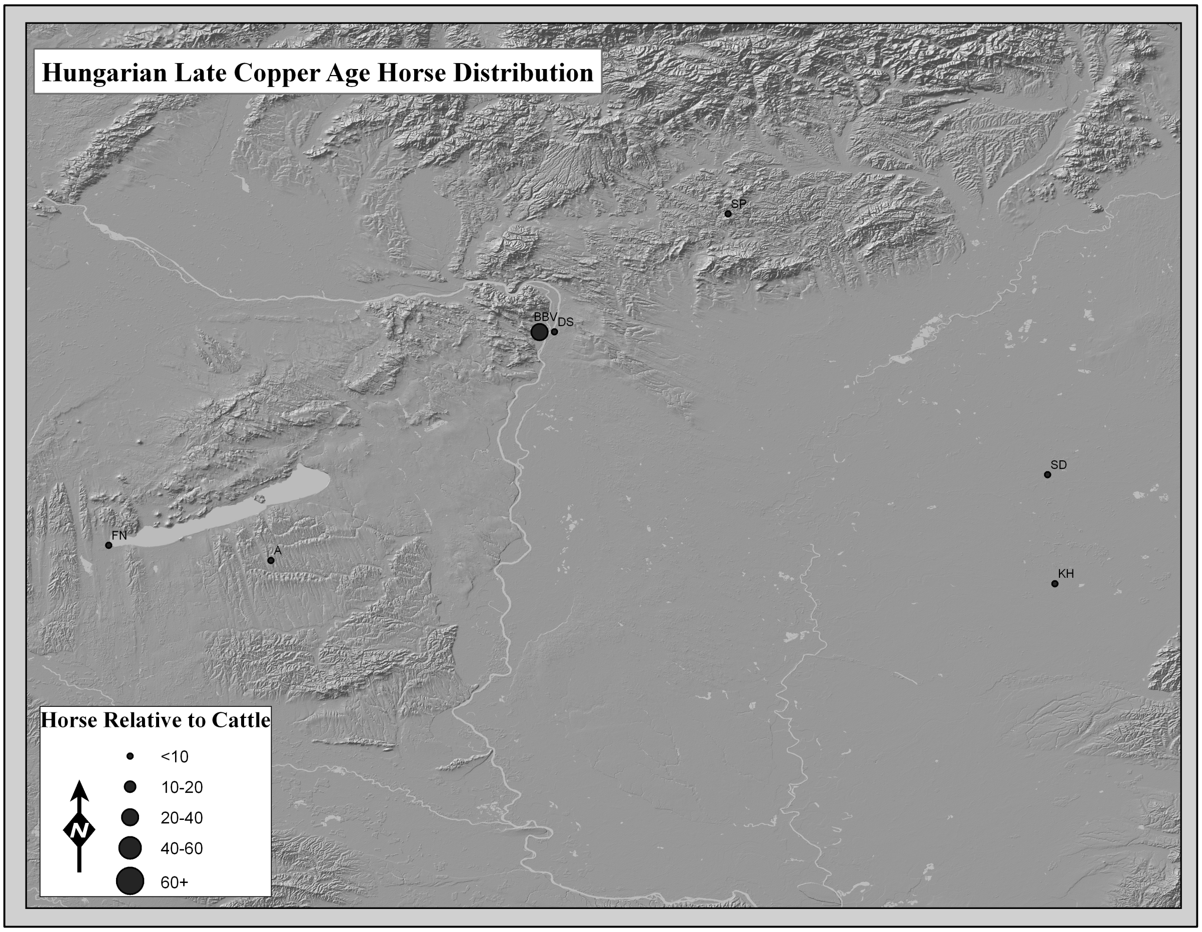

Figure 3.8. Map of LCA horse distribution in Hungary in HRC.

There was a more obvious influence of equestrians and horses in the LCA elsewhere throughout East and Central Europe. The Usatavo site in Ukraine contained about 16% horse, ranging from 14-11% NISP (Bökönyi 1978; Hančar 1956) and there were possible horse bits and images of horses on stele and pots recovered (Zbenovič and Bibikov 1974). Horses were widespread across Transcaucasia, and larger horses were present at Baden, Bernberg in central Germany, 10-20% NISP horses (Benecke 1994:73–74), and at the Cham site in Galgenburg, Bavaria, 20% NISP horse (Benecke 2006).

As the equestrian stockbreeders took up residence in areas abandoned by local agricultural groups throughout the Carpathian Basin, sheep populations show an increase in size that probably reflects their increasing use for wool (Bökönyi 1974; Sherratt 1983). The Carpathian Basin was most certainly an important center and vector for horses and the expansion of economies based on animal husbandry.

> This bridgehead seems to have acted as a point of dispersal both for wool-sheep and for the horse, which spread into the North European Plain where the sandy areas of this marainic landscape were increasingly opened up by plough cultivation…this more extensive form of agriculture made possible the expansion in the use of livestock…The Carpathian Basin acted as an important center of dispersal for steppe element in Europe, and its links to the North European Plain carried advanced types of stock-raising to the Atlantic Seaboard by the third millennium BC (Sherratt 1983:100–101).

The breeding of domesticated horses in Europe was underway by 3000 BC. People were apparently selecting for specific phenotypes in their horses as "a rapid and substantial increase in the number of coat colorations is found in both Siberia and East Europe beginning in the fifth millennium B.P." (Ludwig et al. 2009:485). Also at roughly 3000 BC, the earliest antler bit cheekpieces, resembling later finds of Bronze Age Hungary, were recovered from rich male graves of three Funnelbeaker culture sites in East Germany, another at Bernberg in Central Germany, and also from northern France (Behrens 1981:13; Lichardus 1980; Sherratt 1983:92). The earliest horse burials from Austria date from this time (Pittioni 1954:247).

The Early Bronze Age: 2800/2700 – 2000/1900 BC

Broadly, the beginning of the EBA was divided between two major ceramic styles that define cultural networks over the Carpathian Basin (Figure 3.9): the Makó-Kosihy-Čaka and the Late Vučedol/Somogyvár-Vinkovci (Bóna 1992; Fischl et al. 2013; Kulcsár 2009). These groups

had a two-tier settlement hierarchy and little social stratification. By the second half of the EBA, the Yamnaya expansion fully infiltrated the Central Europe and another group, the Bell Beakers, appeared. Simultaneously, new local cultural traditions emerge along the Danube, Tisza, Berettyó, and Maros Rivers including the Proto-Nagyrév/Nagyrév, Nyírseg, Gáta, Wiselburg, Kisapostag, Maros/Perjámos, and Ottomány/Hatvan.

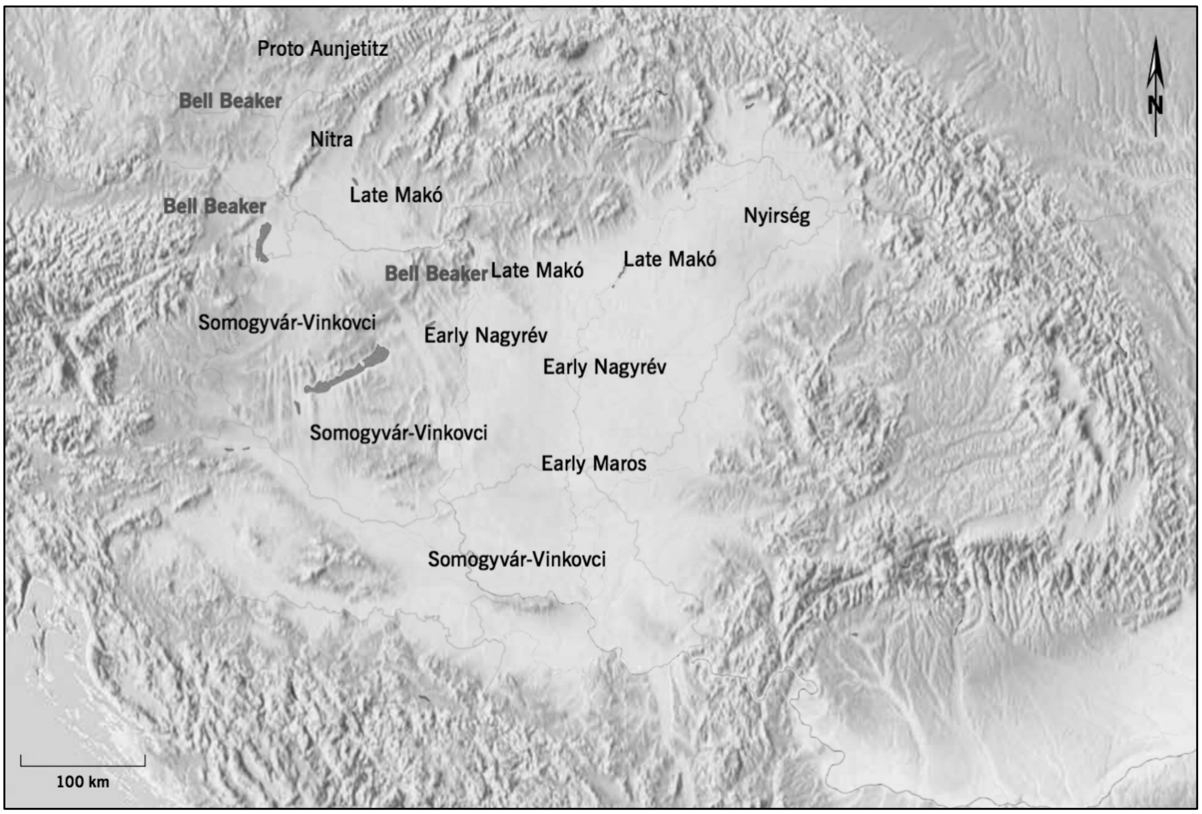

Figure 3.9. EBA Cultures in Hungary (Fischl et al. 2015:508, Figure 3).

Human-induced changes to the Hungarian landscape increased in the EBA and were correlated somewhat with larger climatic processes of the Sub-Boreal, including a warmer and wetter sub-phase at the beginning of the EBA. There was a mosaic of climatic zones that influenced regional developments (Fischl et al. 2015; Sümegi and Bodor 2000; 2005). "In central Hungary,

human impact in the earlier Holocene led to the creation of a substantially open and grassland-dominated landscape by the Early Bronze Age. The implication is for long-term sympathetic land management practices…with a predominance of grassland for grazing over intense arable cropping" (French 2010:55–56). Because of human management and the very productive pastures and easy access to water, more intensive sedentary animal husbandry was possible by the EBA. People could occupy a much smaller region and husband rather larger herds animals than ever before.

At the beginning of the EBA, large-scale horse husbandry is evident in Central Europe, in the Carpathian Basin in general, and the central Balkans in particular (Bökönyi 1974, 1978; Greenfield 2006:221–222). The Bell Beaker horizon started at 2750 cal BC (Olalde et al. 2017, 2018). Along with the Yamnaya, who are well known to have horses, the Bell Beakers have been identified as the probable contenders for the early diffusion and spread of horse husbandry and its spread throughout Europe during the EBA (Bendrey 2012; Bökönyi 1978; Harrison and Heyd 2007; Uerpmann 1990). The Bell Beaker culture was a widespread set of practices, generally identified by their distinctive beaker shaped pottery and grave goods, found across much of Europe. They show evidence of increasing stratification and their mobility is underpinned by their rapid diffusion and the presence of horses at their settlements, especially in Hungary. They also show evidence of genetic and cultural interaction with the Yamnaya.

A Bell Beaker from Szigetzenmiklós dating from 2500 BC – 2100 BC (cal) has the highest Yamnaya ancestry of any Bell Beaker, or of any western European; another individual from same cemetery has no Yamnaya ancestry, which may reflect horse trade and networks that connected different people (Olalde et al. 2017; 2018). Ancient human and equine genetics have converged

nicely recently, which highlight that Hungary was indeed a center for the influx and spread of both people and horses from the end of the Copper Age and into the EBA.

> All domestic horses dated from ~4,000 ya to present only show ~2.7% of Botai-related ancestry. This indicates that a massive genomic turnover underpins the expansion of the horse stock that gave rise to modern domesticates, which coincides with large-scale human population expansions during the Early Bronze Age (Gaunitz et al. 2018:111).

This most recent research in ancient equine genetics have indeed located the horse that is most ancestral to all other domesticated horses is from the EBA site of Dunaújváros-Kosziderpadlás, and dates to 2139 –1981 cal. BC (Gaunitz et al. 2018:Supplement p. 4). There were also horses present, two horse skulls, in a Bell Beaker cremation burial at Vyškov, Moravia, Czech Republic (Ondráček 1961). Additional likely ritual horse depositions are known within the Czech territory from the EBA (Kyselý and Peške 2016).

It was on the island of Csepel-Harós in Budapest, 2500 BC – 2200 BC, that most impressive evidence of the Bell Beaker horse culture was revealed. At the site of Cspel-Hollandi út 33, over 60% of the animal bones were horses (Benecke and von den Driesch 2003; Bökönyi 1974). Similar percentages were present at Albertfalva (Endrődi and Reményi 2016a; Lyublyanovics 2016) and Szigetzentmiklós (Patay 2013). “The communities of the Csepel group enjoyed a flourishing economy on their large rural settlements. They played a prominent role in the spread of a steppean horse species” (Endrődi et al. 2008:252–253). A strong tradition of horse husbandry and incipient equestrianism is indicated as horse bones vastly outnumbered the remains of cattle and small ruminants on settlements of the Csepel group (Endrődi 2013:704) (Figures 3.11 and 3.15). Horses were butchered like other domesticates, but there is also some evidence of riding related pathologies.

"The Bell Beaker groups located on the Danube and its tributaries seem to have had an economy based both on agriculture and animal husbandry, including especially horse breeding probably involving trade with local Makó and early Nagyrév settlements (Kalicz-Schreiber and Kalicz 2001:441ff)" (Artursson 2010). Poised on good grazing lands and comprised of single farmsteads and small villages, the Bell Beaker settlements varied in size, but were rather regular in their boat shaped house form and size and in their use of pits. Households seem to have had a measure of independence with their own working areas. Moreover, each house appears to have had stabling for animals (Endrődi and Reményi 2016b).

The Bell Beaker Csepel Group around Budapest was related to and interacted with other cultures developing in the same region, especially the Nagyrév. In northwest Hungary the Nagyrév became the Vatya of the tell polity of Százhalombatta and the Benta Valley. "Wedged in the heartland of the proto-Nagyrév distribution, the Bell Beaker Csepel Group controlled strategic points of the Danube and thus occupied a key position on the eastern border of the Bell Beaker culture" (Endrődi et al. 2008:206–207). But they remained independent in the midst of proto-Nagyrév expansion during the EBA. Other cultures nearby cultures from 2500 BC – 1900 BC are the Nyirség (NE Hungary), and the Kisapostag (W Hungary).

Geographically closest to the Bell Beaker settlements, the Nagyrév settlements are larger, denser, and more permanent than the Bell Beaker occupations (Artursson 2010). Like the Bell Beakers, the Nagyrév sited their settlements along the Danube, but unlike the Bell Beakers, ditches often protected their sites or were used to corral livestock. The Nagyrév began the tell building tradition but have open settlements as well As a vast number of EBA settlements were situated on the best soils in the EBA (Bartelheim 2009) these settlements of the Benta Valley and at its largest

tell of Százhalombatta-Földvár are all on some of the richest grazing lands in all of Europe. The 'off tell' settlements were on small rises in the terrain, on or very near streams (Figure 3.10). This settlement structure implies animal agriculture was predominant in the valley, which is supported by the zooarchaeology and paleobotany, and paleogeology from EBA excavations (French 2010; Poroszlai 2000; Sümegi and Bodor 2005; Vretemark 2010).

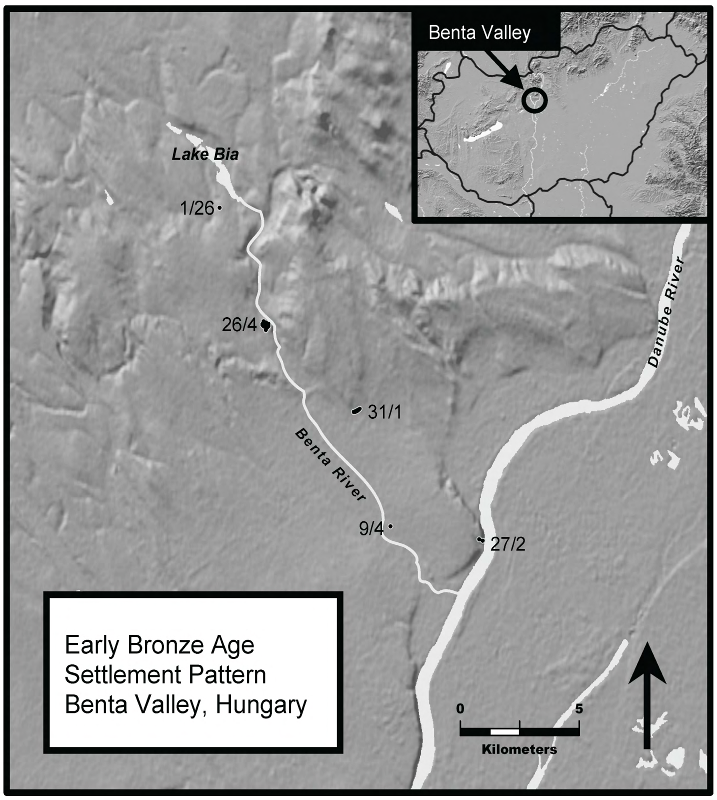

Figure 3.10. EBA Settlement in the Benta Valley.

The Nagyrév tell settlements were large (2ha and 200 people estimated), but individual households, streets, and open areas are clearly defined. Four off tell sites range from a 4.75 ha settlement, with a very dense 2.25 ha core, of an estimated 300 people at Sóskút, to a hamlet at Tárnok, and two isolated farmsteads at Érd and Bia, which would later become a hillfort (Artusson

2010). One Bell Beaker type, boat shaped, longhouse was found at Érd which is indicative of close interactions and likely intermarriage between the Bell Beakers and Nagyrév. From early on, defining community, household, 'on tell' and 'off tell' settlements perhaps materializes the confluence of new human relationships that emerge from the cultural convergence of the local sedentary farmers, Yamnaya, and Bell Beakers for the first time on these new settlements. The Nagyrév of the Benta Valley and Százhalombatta mark the beginning of a nearly a millennia of continuous occupation of the same sites and is the origin of the Benta Valley polity.

Comparatively, EBA animal husbandry varied substantially from region to region with different settlements even within regions having much different strategies of livestock production (Figure 3.11). Most settlements had cattle in the highest frequency but variance can be seen in this range from 16-85% NISP of the total assemblage of domesticated animals (Figure 3.12). The Kisapostag settlement of Ravazd-Villibald-domb overwhelmingly husbanded ovacaprids and had much lower amounts of cattle and swine (Figure 3.13). Only the Nyírség settlements clustered together in a similar fashion and both have the highest frequency of swine (Figure 3.14). There seems to have been a trend where the sites with more horses had less dogs and vice versa, but there are also exceptions as shown in Figure 3.15. This may be related to different herding strategies, as the people without horses used more dogs to herd their livestock and those who had horses, used them in their transhumance. Figures 3.11 – 3.15 highlight the tremendous varieity in livestock husbandry regimes by settlement and culture.

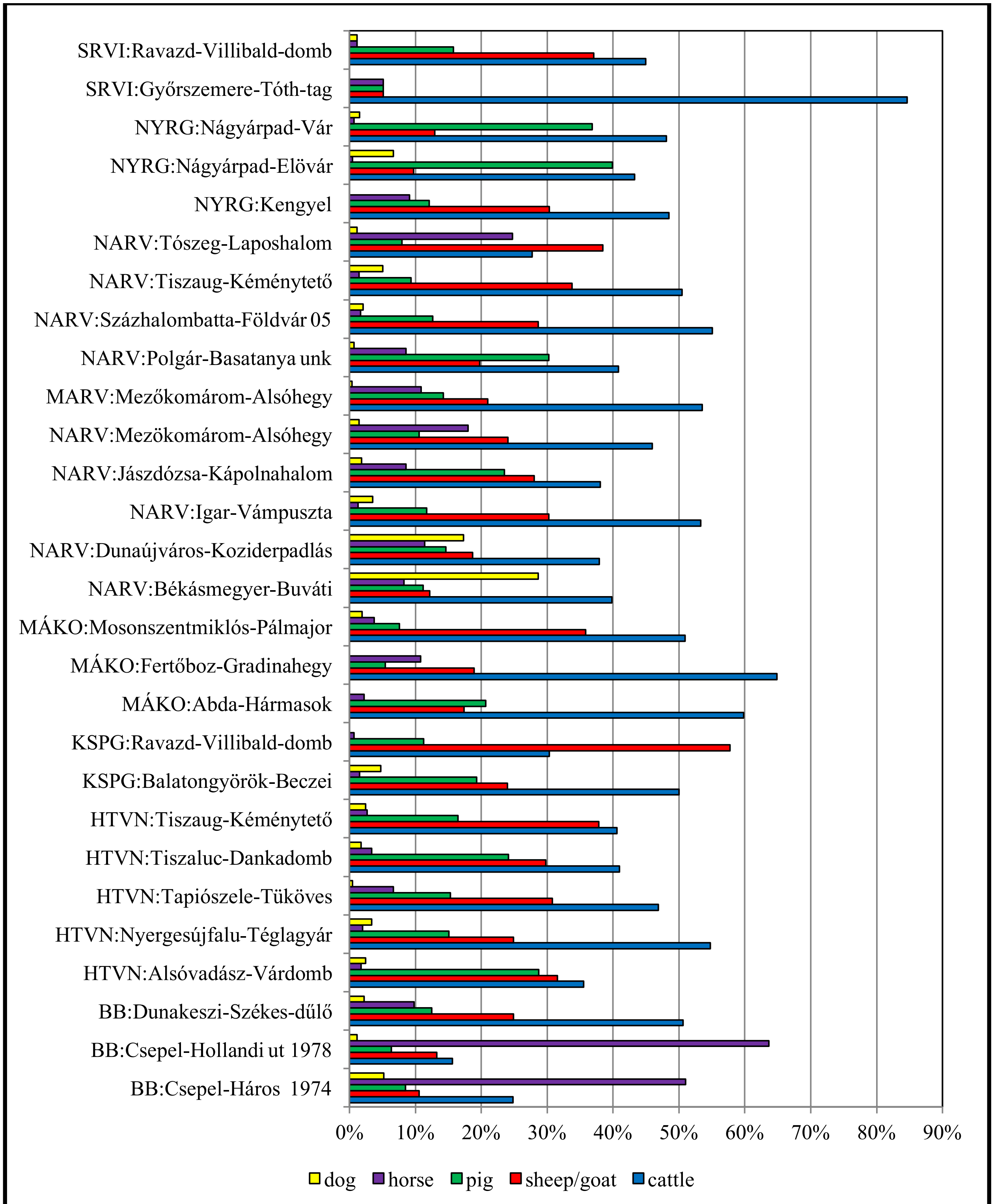

Figure 3.11. Relative Frequencies of Domesticated Animals in NISP % from EBA Settlements with Cultural Affiliations.

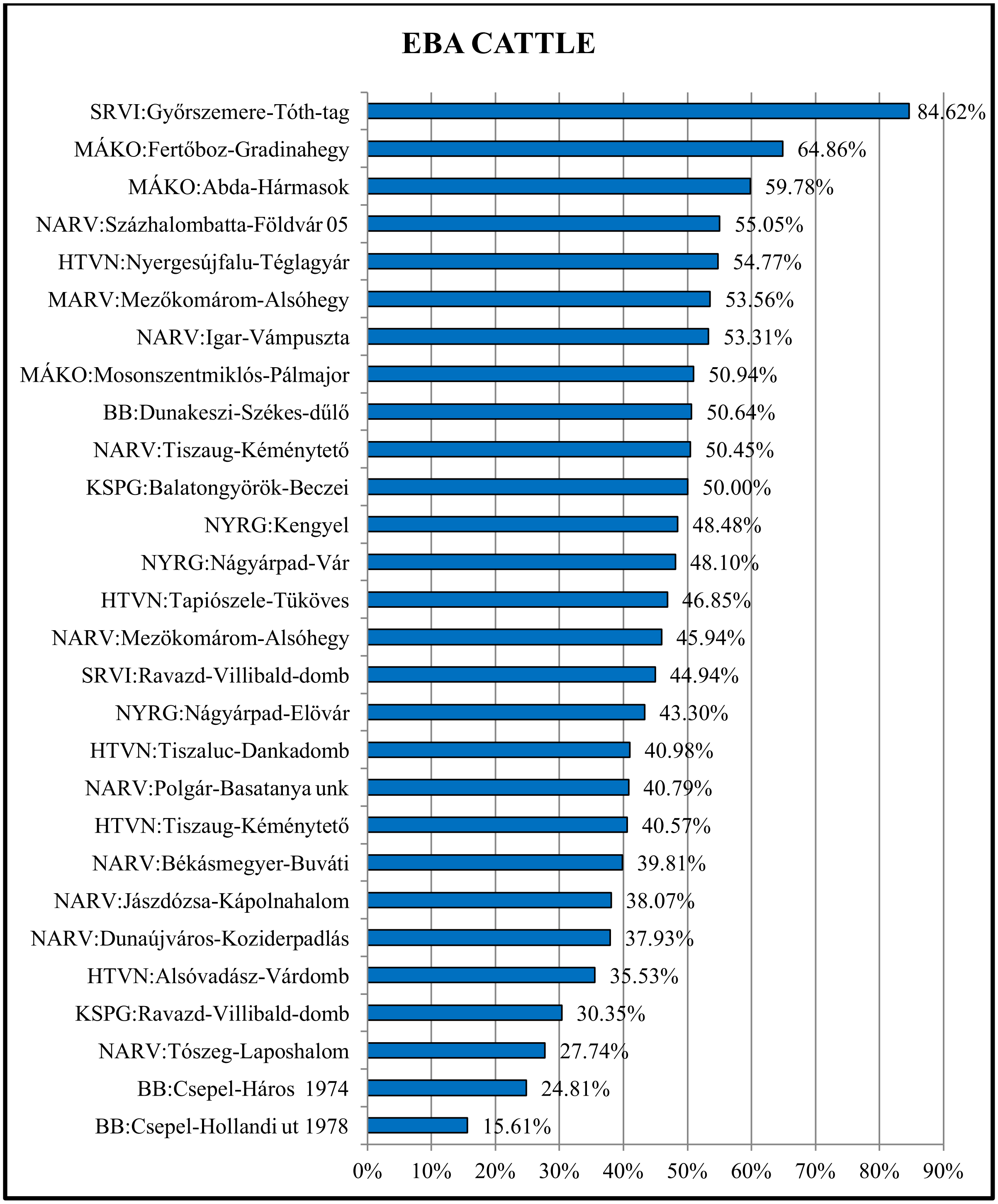

Figure 3.12. Cattle Frequency Sorted by NISP % at EBA Tell Settlements.

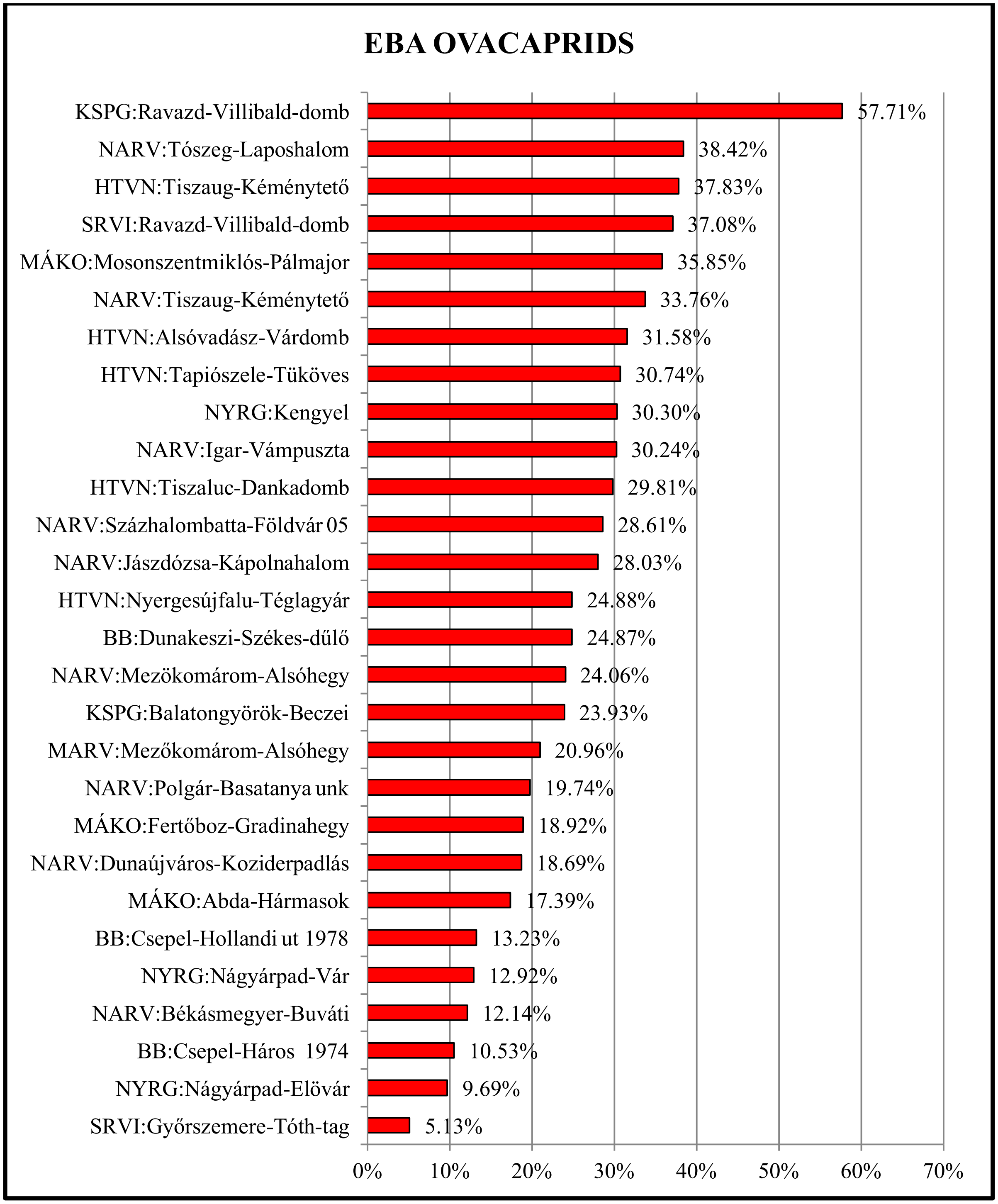

Figure 3.13. Ovacaprid Frequency Sorted by NISP % at EBA Tell Settlements.

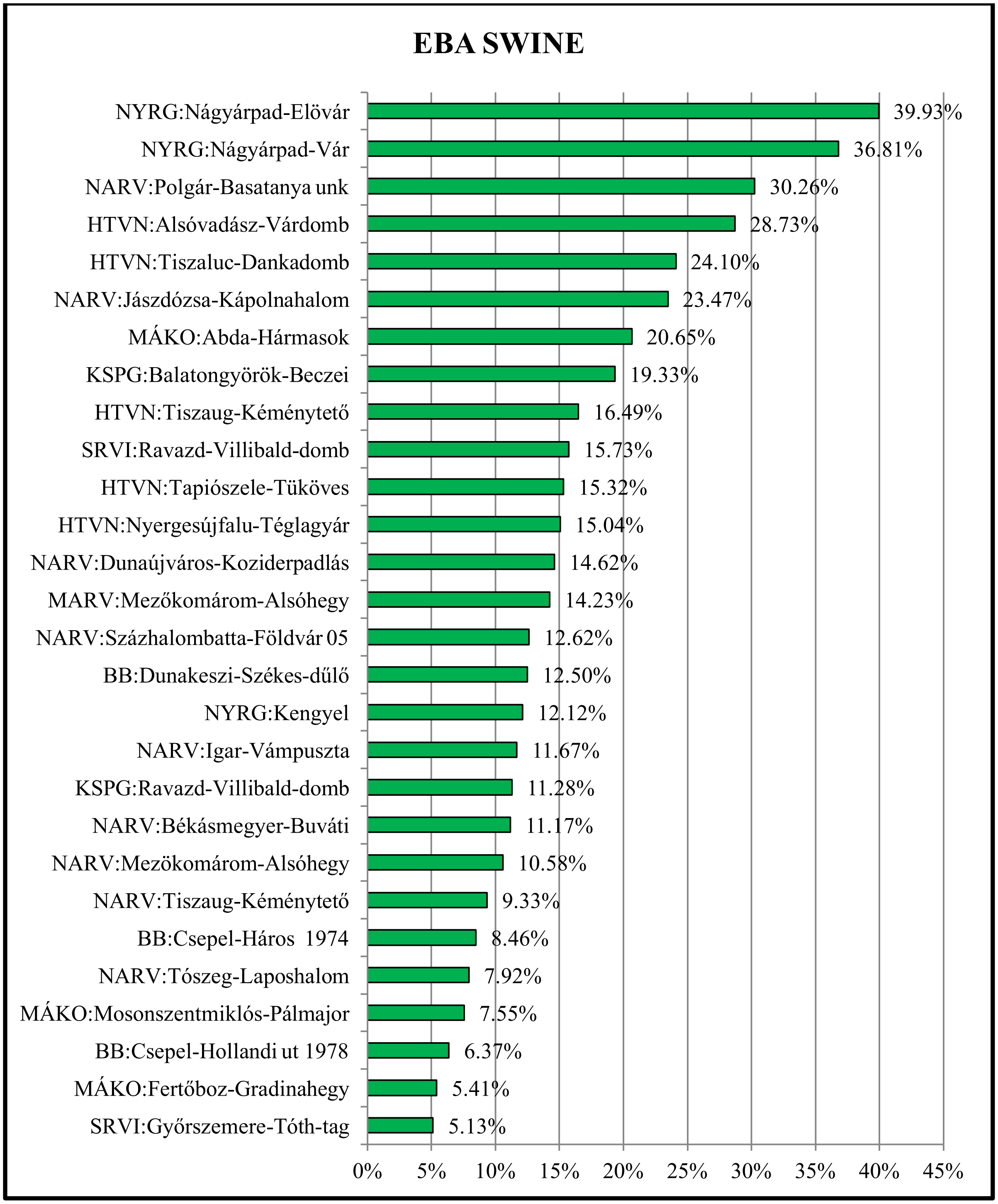

Figure 3.14. Swine Frequency Sorted by NISP % at EBA Tell Settlements.

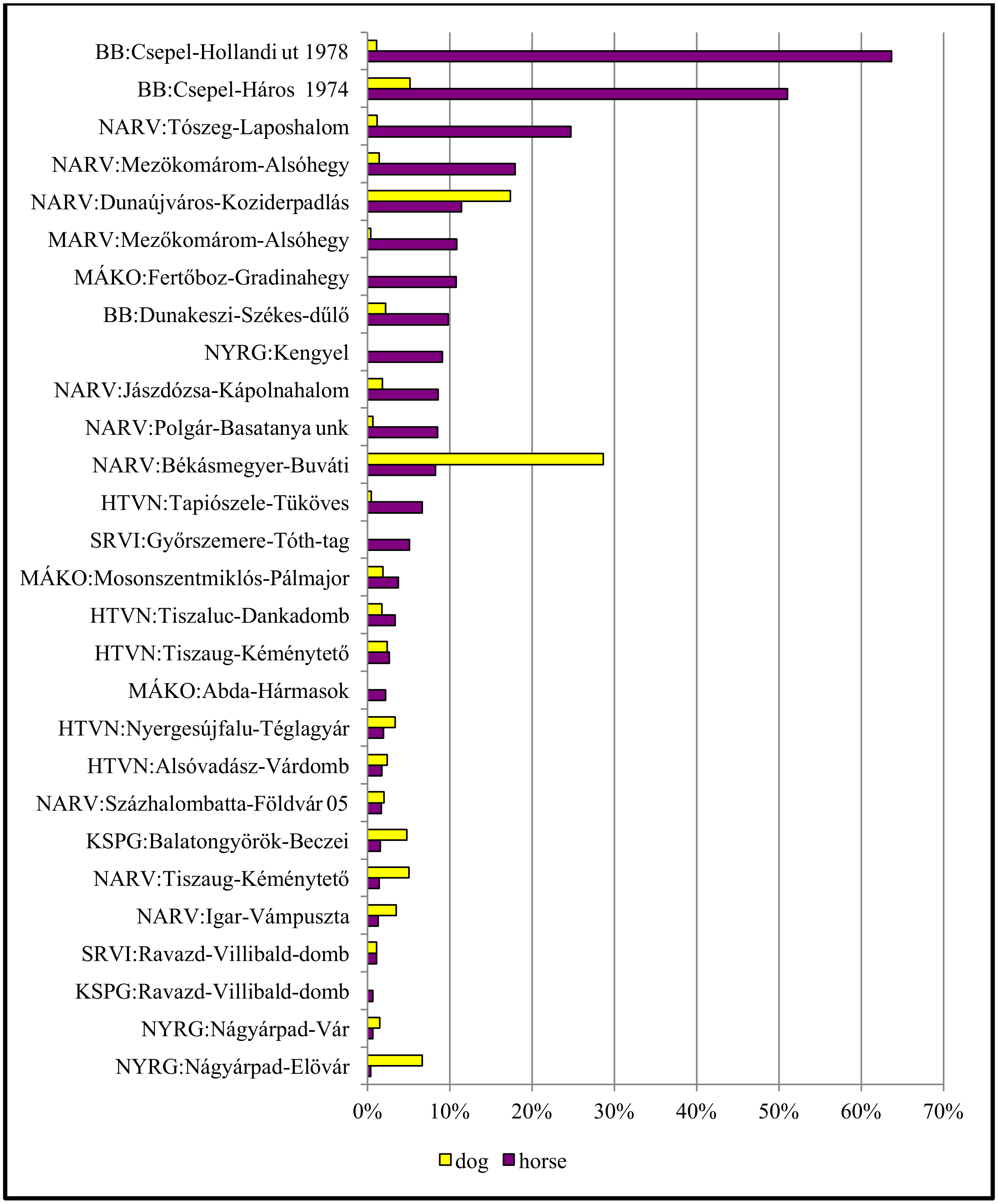

Figure 3.15. Horse and Dog Relative Frequencies Sorted by NISP % at EBA Tell Settlements.

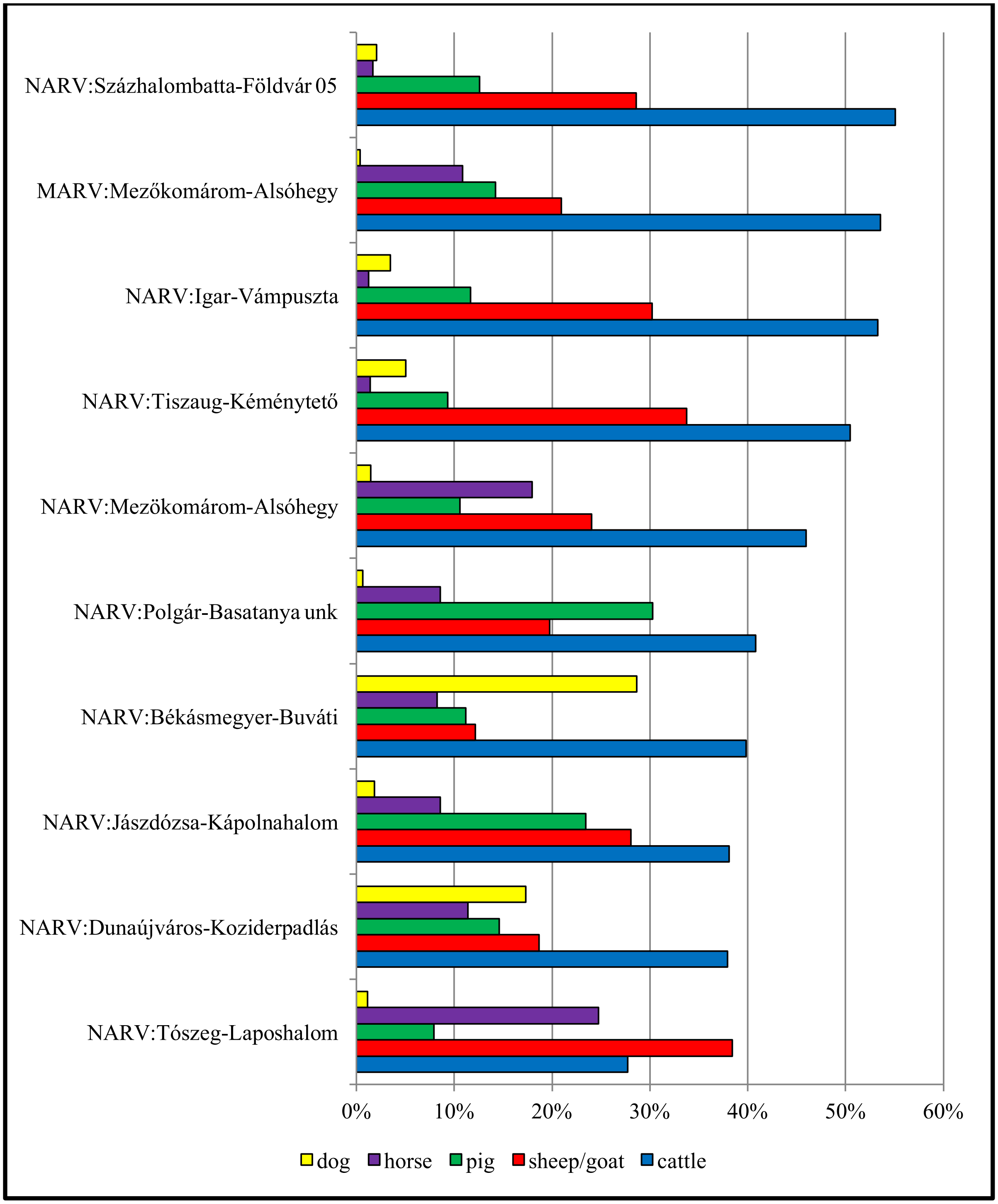

Figure 3.16. EBA Nagyrév Relative Frequencies of Domesticated Animals in NISP%.

Determining any sort of specialization in secondary products is difficult without the presence of age classes of each species. Culling strategies help to determine the primary and secondary uses of animals (Reitz and Wing 2008; Sherratt 1981). Data from Nagyrév sites indicates a focus on primary products in the EBA, with variance in primary animal preference demonstrated in Figure 3.16. The Nagyrév site of Tiszaug-Kémenytető illustrates a meat-oriented culling, with juveniles and sub-adults of cattle, ovacaprids, and swine (Choyke and Bartosiewicz 1999; 2000). Animal husbandry at the Nagyrév sites of the Benta Valley were dominated by cattle for meat and and their secondary use for traction, followed by ovacaprids and swine that also exhibited meat-oriented demography (Vretemark 2010) (Figure 3.17).

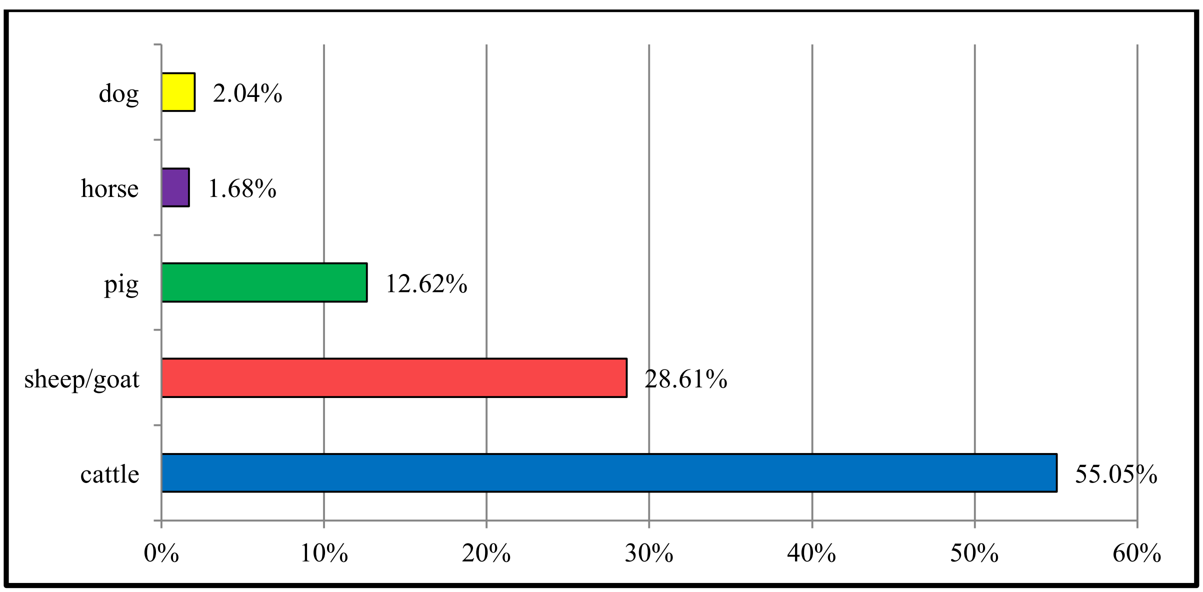

Figure 3.17. EBA Nagrév Animal Husbandry at Százhalombatta-Földvár in NISP %.

The animal husbandry practices of the EBA Nagyrév of the Benta Valley may have continued the Yamnaya type traditions at a more sedentary base like the Bell Beakers of Csepel-Harós, using both mounted herders and pedestrian herding with dogs. Animals could have been

pastured within the purview and direction of the peoples of the off tell settlements, or kept within the ditch enclosure of the tell and taken to pasture on a daily basis, or have been conducted with some combination of the two. While excavations at the tell of Százhalombatta have not recovered evidence of stabling for animals within structures there, only a 20x20 m^2 section of the central village and several small test excavations of the much larger enclosed tell have been opened. Questions remain about how the animals were herded or pastured in the Benta Valley. The ditch fortification built at Százhalombatta in the EBA, and others like it, have been suggested to be related to keeping livestock within the purview of the people inhabiting the tell (Parkinson and Duffy 2007).

Bökönyi (1978) documented horse keeping in NISP % among these EBA contemporaneous societies. Settlements closest to the Bell Beaker Csepel Group husband a larger number of horses than those at a greater distance, mapped in Figure 3.18, but the total number of horses in the EBA of Hungary is substantially greater than in earlier periods. Figure 3.19 illustrates the relative amounts of horses between cultural groups.

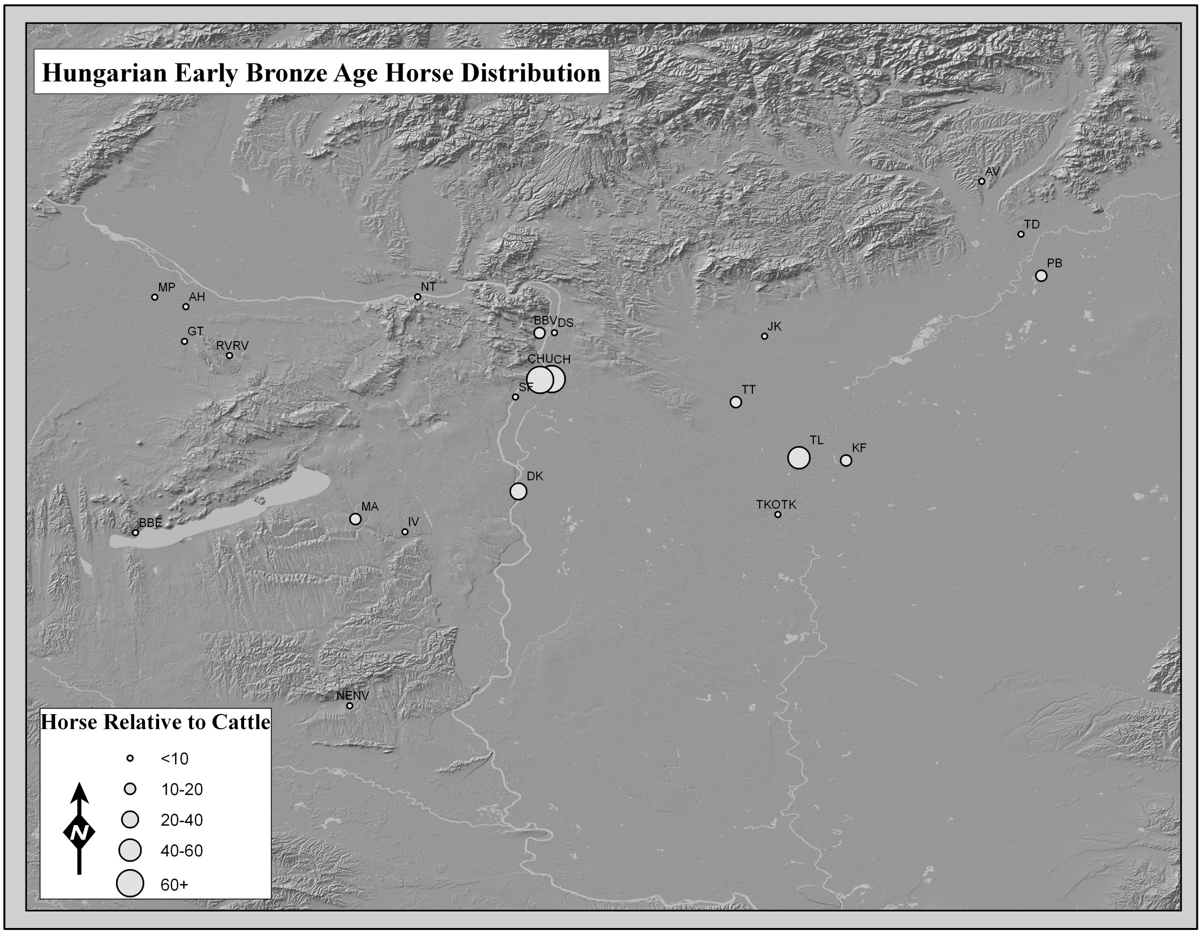

Figure 3.18. Map of EBA Horse Distribution in Hungary in HRC.

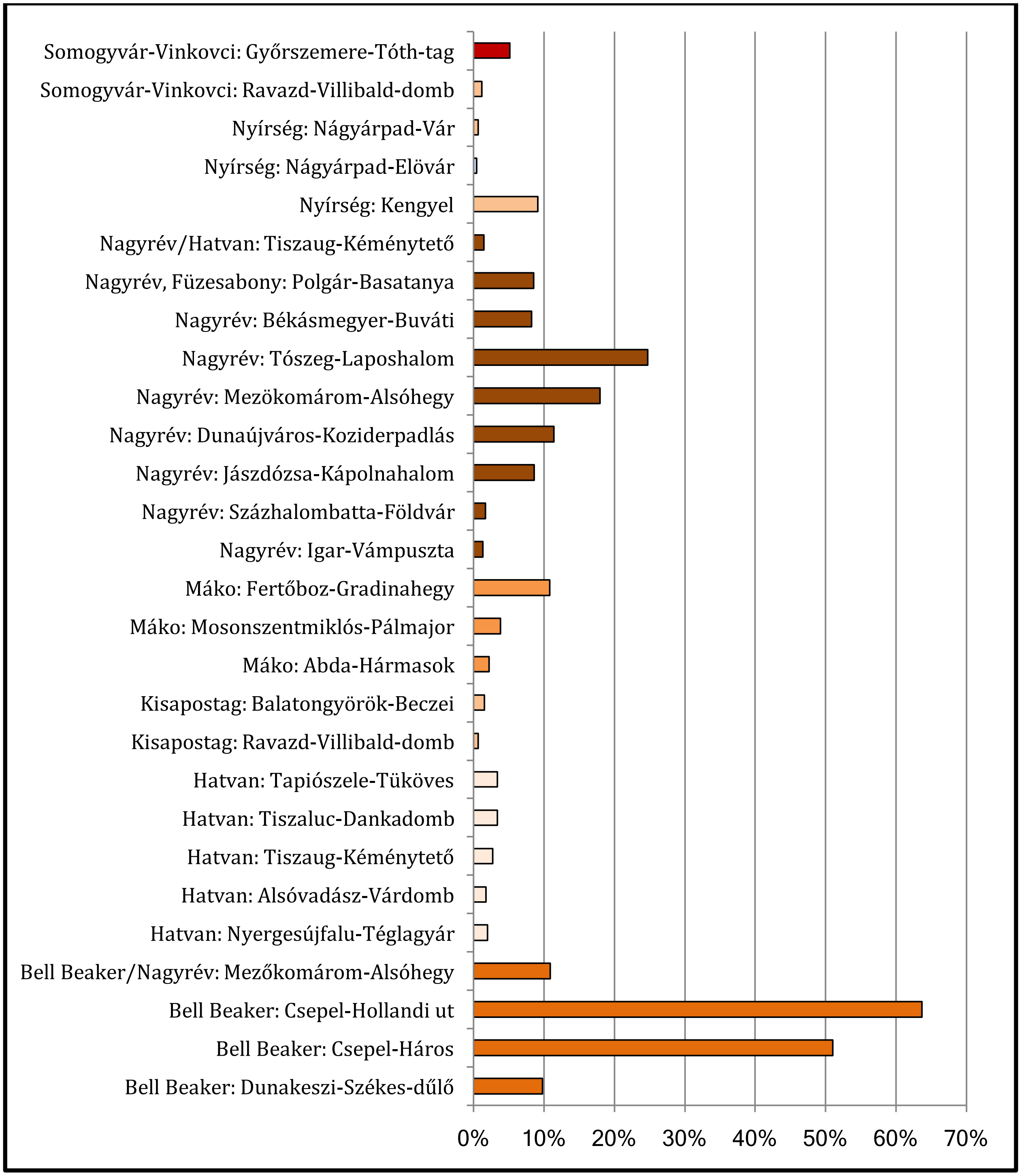

Figure 3.19. EBA Horses Expressed as NISP %.

People began making horse bits out of red deer antler in the EBA (Bökönyi 1953; Bándi 1963; Choyke et al. 2004; Hüttel 1981; Mozsolics 1953). The first cheekpiece from a horse bit in Hungary is documented at Hatvan size of Nygergesújfalu-Télagyár (Northwest Central Hungary on the Danube River) dating between 2200-1750 BC. Bits have been subsequently recovered widely at EBA sites throughout Hungary, mapped in Figure 3.20.

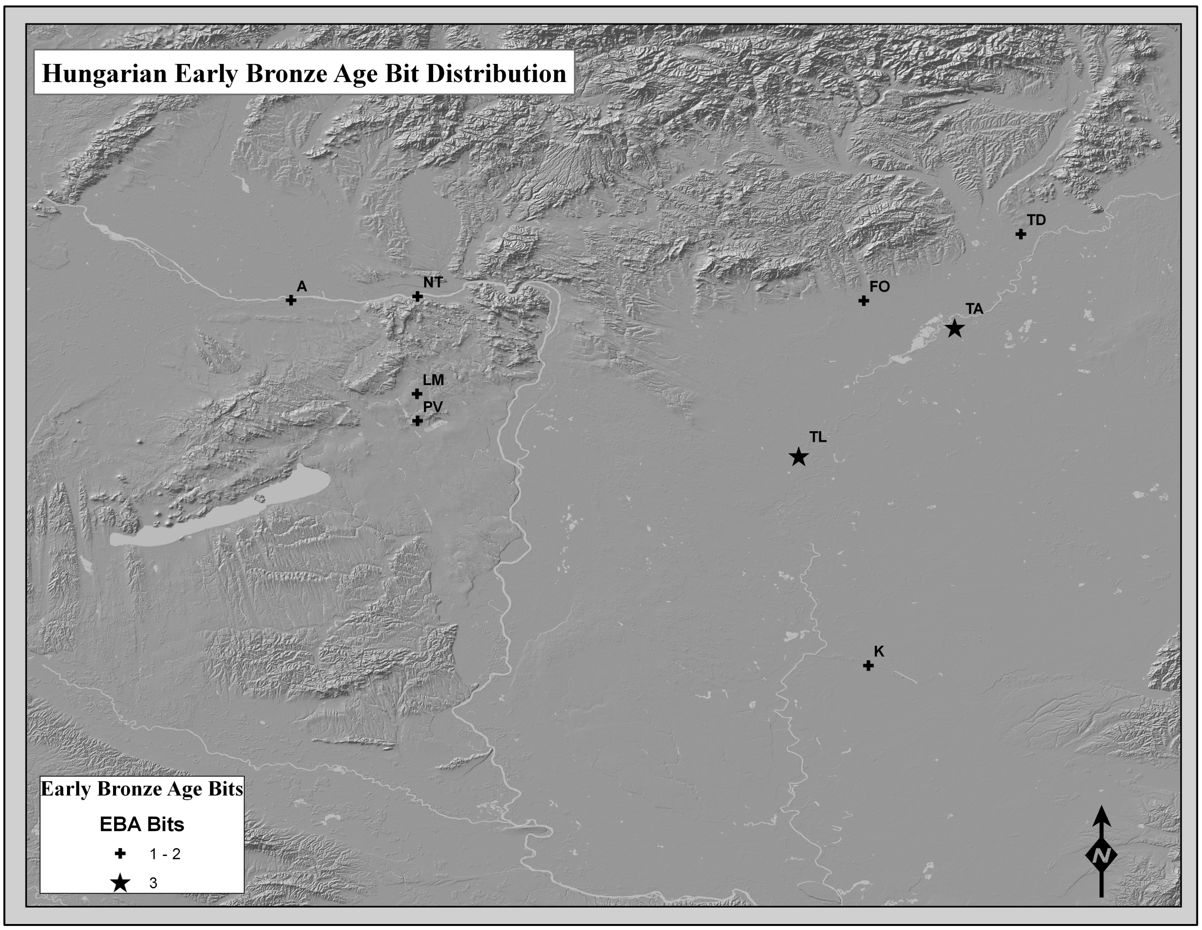

Figure 3.20. Map of EBA Bit Distribution in Hungary.

Horse husbandry and equestrianism was developing and expanding exponentially with EBA cultures in Hungary, while on the Pontic Caspian steppes, c. 2100 BC – 1800 BC, the

Sintashta and Poltavka Cultures emerged with a very specific new horse culture: one of chariots (spoke wheeled light war chariot), horse sacrifices and disc cheekpieces, fortified settlements, and major metal production. Every house has evidence of metal production, while a minority of graves have horse sacrifices, but those that do have weapons.

> Between 2100 and 1800 BCE they invented the chariot, organized themselves into stronghold-based chiefdoms, armed themselves with new kinds of weapons, created a new style of funeral rituals that involved spectacular public displays of wealth and generosity, and began to mine and produce metals on a scale previously unimagined in the steppes. Their actions reverberated across the Eurasian continent (Anthony 2007:411–412).

While these horse-related developments on the Pontic Caspian steppes are roughly contemporaneous with the development and spread of horse husbandry in EBA Hungary, they should not be considered as the same thing or that chariotry immediately spread into Europe (contra Earle and Kristiansen 2010; Kristiansen 2016; Kristiansen and Earle 2015; Vandkilde 2014). The chariotry complex was quite different from the equestrian traditions in place in Hungary in the EBA. Each type of horse specialization emerges out of different contexts and traditions and for very different reasons. In Chapter 6, I expose these differences with a discussion of the radically different bits and terrains where each has been found, highlighting some of the impossibility of driving a chariot throughout much of the terrain of Bronze Age Hungary where horses were largely present. Besides a few clay models, evidence for obviously horse drawn wheeled vehicles does not occur until the Iron Age.

Review through the EBA

To recap, people and horses have had millennia long relationships that intensified and coalesced in horse domestication on the Pontic Caspian steppes sometime between the fifth and

fourth millennium BC. Almost as soon as horses appeared in cultural contexts that implied this new relationship, they showed up on settlements in the Carpathian Basin. Centuries of interaction between Copper Age Hungarian cultures and those of the Pontic Caspian steppes meant that horses, horse husbandry, and equestrianism were part of the ideas and innovations traded into the region, like new conceptions of family, property, and interitence. Heyd (2016:81) describes this period as,

> A long-term process of promoting individualization, gender differentiation, warrior ideals, and internationalization unfolds from the mid-4th throughout the 3rd millennium BC that changes the social and economic foundations of the inhabitants of the European Continent forever…More than this: such a profoundly transformed human-animal relationship must have had a comprehensive impact on settlement and social organization, on what people predominantly eat, how they live, and what they look like. In consequence, these innovations fundamentally affected the basics of societies, and must have thus challenged the whole system of ideas, imagination, morals, symbols, terms and even language – a new world-view. In turn, they created the wider framework for the emergence and expansion of super-regional ideologies.

However, this does not mean that these ideas remained static or in place for the variety of cultures that developed and began building the tells in the EBA. These societies were sedentary animal agriculturalists; their husbandry practices were tethered to pastures and water sources with large villages, hamlets, and farmsteads. By the EBA, there is evidence of intensive, full-scale horse breeding at Bell Beaker and Nagyrév settlements, from which horses were dispersed throughout the region. Sedentary based animal husbandry requires a more communal effort in organizing grazing. These practices, along with craft and metallurgical production, had to be more collectively organized. Such coroporate labors may have reduced tendencies towards centralized hierarichal rule and marked social stratification brought into the region by peoples such as the Yamnaya.

CHAPTER 4

Chronology, Cultures, and Contexts Part Two: Herding and Travel to Politics and Warfare, The Dissemination and Spread of Horses in the Middle and Late Bronze Age of Hungary

The Middle Bronze Age: 2000/1900 – 1500/1450 BC

The Proto-Nagyrév/Nagyrév, Otomany, Nyírség, Hatvan, Maros/Perjámos, and Kisapostag of Hungary developed into the MBA Vatya inhabiting the Danube valley and Danube-Tisza interfluve, the Gyulavarsánd/Ottomány in the Berettyó-Körös region, the Füzesabony occupying the Middle and Upper Tisza region and the Bodrog and Hernád Valleys, the Maros on the Tisza and Maros Rivers, and the Transdanubian Encrusted Pottery Ware cultures over Transdanubia (Bóna 1975; 1992; Dani 2012; Kiss 2012b; Kovács 1997; Kovács and Stanczik 1988; Máthé 1988; Poroszlai and Vicze 2000; 2005) (Figure 4.1).

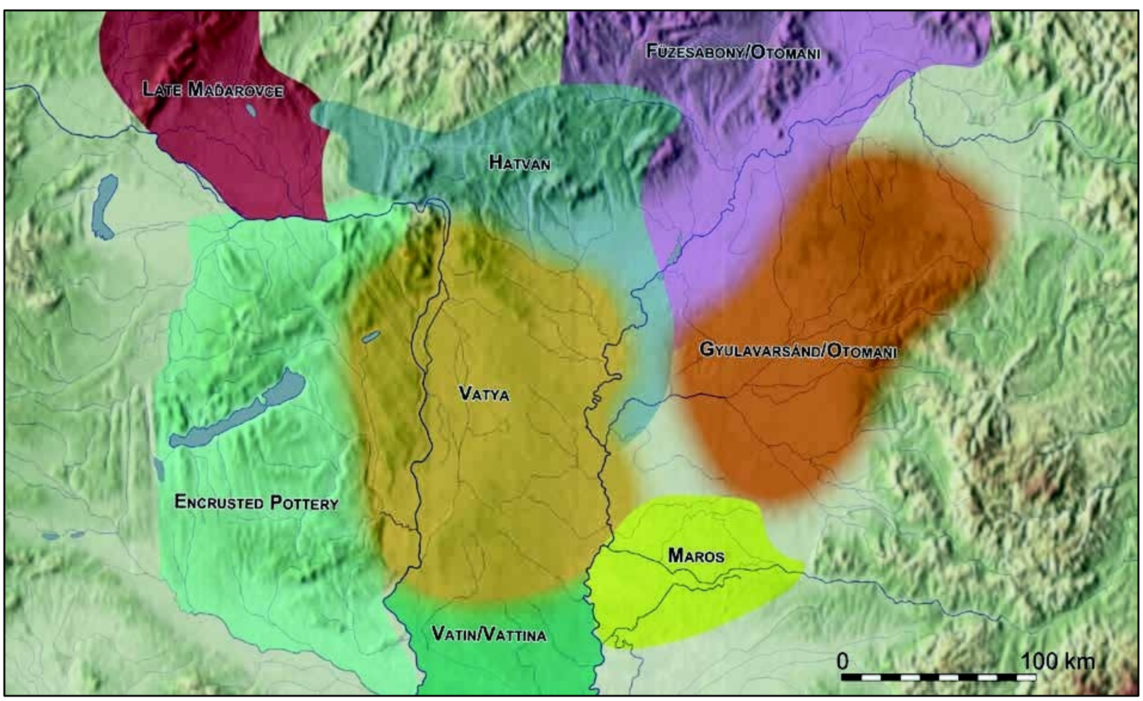

Figure 4.1. MBA Cultures in Hungary (Fischl et al. 2013:357, Figure 2).

Other MBA cultures present included the Mad'arovce in the northwest corner of Hungary and the Vatin in the far southeast). Again, these cultures are discussed as defined by Hungarian archaeologists primarily by their pottery styles, settlement patterns, and burial customs. The MBA was the florescence of these tell culture traditions of Hungary (Fischl et al. 2013; Gogâltan 2018; 2008; Poroszlai 2003a). The classic narrative is that,

> the archaeological record shows the formation of organized, semi-urban tell settlements and settlement territories developing with local and long distance exchange networks. Large cultural territories can be observed in the formation and presence of geographically defined symbolic boundaries, expressed primarily in pottery. These boundaries are traditionally seen as demarcations of different ethnicities and political identities, related to the development of more hierarchical forms of authority (Uhnér 2005:745).

The changes marking these cultural traditions into the MBA were peaceful and built upon the earlier cultural signatures, but generally delineate population growth and aggregation. The number of settlements, including villages and hamlets on and off the tells, and their sizes and densities increased dynamically in most regions from the EBA to the MBA (Dani 2012; Duffy 2010; Earle and Kolb 2010; Fischl et al. 2013; 2015; Szeverényi and Kulcsár 2012). Systematic surveys of the Benta Valley illustrate a greater than tripling of population and residential areas and a near tripling in the number of settlements (Artursson 2010). However, most (64%), of the population lived on unfortified, open settlements including large villages, smaller hamlets, and farmsteads with the largest village at Tárnok over twice the size and nearly double the population of the tell at Százhalombatta. In the Benta Valley, (Figure 4.2), there were 13 additional Vatya settlements identified with four hillforts varying in size from 1-5.5 ha and 50-310 people, six villages from 2-12.5 ha and 80-550 people, and three smaller hamlets (Earle and Kolb 2010).

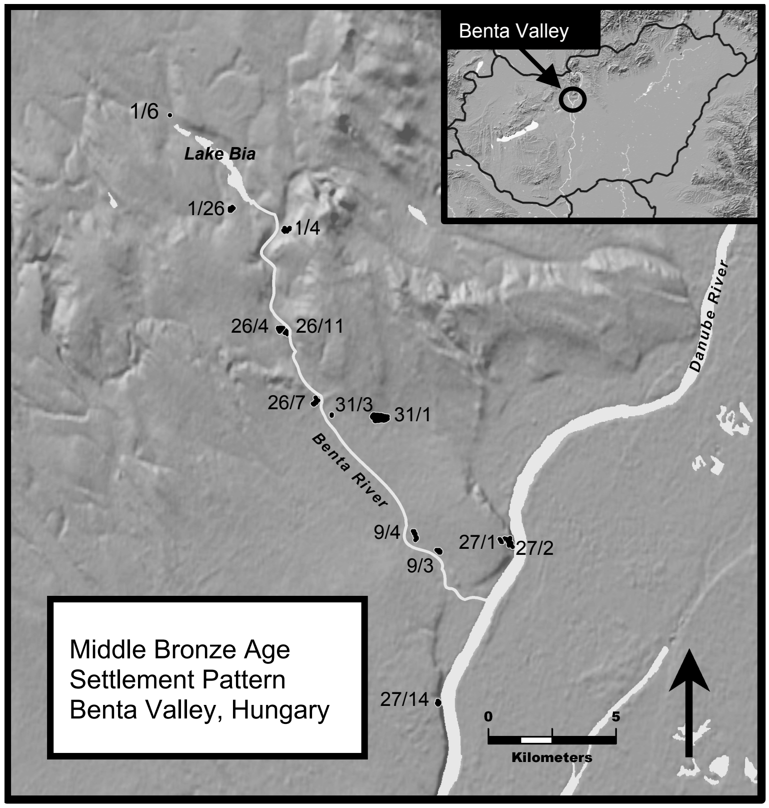

Figure 4.2. MBA Settlement Pattern in the Benta Valley.

The size and number of settlements is also observed from surveys in the Vatya Kakucs region (Szeverényi and Kulcsár 2012), the Kisapostag areas of west Hungary, and the Gyularvarsánd area in SE Hungary, while in the Füzesabony Borsod Plain in northeast Hungary shows sparser settlement at the same time, indicating some regional variation of MBA growth (Fischl et al. 2013).

As in the Benta Valley, in other regions large off tell villages and hamlets seem to have been common. Whereas in places where tells were constructed above marshy plains, off-tell settlement was impossible due to the environmental constraints and the tells were the only options for aggregated populations (Dani 2012). Fortifications, what defines them, and when they were constructed, however, vary wildly within and across regions (Gogâltan 2008; 2018; Kienlin 2012).

Parkinson and Duffy (2007) assert that fortifications may very likely be an effort of collective identity building rather than enclosures of defensive works. Because some of the largest known villages are unfortified, the majority of the population generally lives in unfortified villages, and the confusion about the timing and presence of fortifications, the importance of fortified sites should not be overemphasized (Artursson 2010; Earle and Kolb 2010). The ditch at Százhalombatta-Földvár was constructed by the EBA Nagyrév then filled in and built over by the Vatya (Poroszlai and Vicze 2005). The MBA practice filling in and building over EBA ditches has also been noted at a number of other MBA tells (Fischl et al. 2013; 2015).

Earle and Kolb (2010:74–75) find the settlement structure in the Benta Valley to be organized along the lines of the way finance was mobilized for the emergent political economy.

> A pattern of open settlements formed a clear site hierarchy, dominated by the large central village of Tárnok, which contained an estimated population equivalent to all other open settlements. As a whole, they appear to be involved primarily with crops and animal production. Could the large settlement at Tárnok (rather than Százhalombatta-Földvár) have been the center of power for the valley chiefdom? Intriguingly, excavations at tell settlements show little evidence of social differentiation in housing, seeming to represent a fairly equal segment of the population. The overall pattern of consumption on the sites and within the cemeteries suggests a common, corporate identity that did not emphasize differences. Despite this apparent equality, the position of fortifications suggests that warriors were critical to Middle Bronze Age society and that Százhalombatta-Földvár was probably the main central place. Perhaps, however, it was dominant only in its sphere of power, reflecting control over emerging luxury trade. The paired central Middle Bronze Age settlements of Százhalombatta-Földvár and Tárnok may represent a continuation from the Early Bronze Age of two distinctive bases of power in staple production and luxury trade. Thus, the new Middle Bronze Age Benta chiefdom could well be an amalgam, a heterarchical structure incorporating within a single polity different sources of power and finance. Thus, Tárnok could have dominated the agricultural communities producing staples and animal products in the valley, and Százhalombatta-Földvár could have dominated the hierarchy of forts, providing warrior protection at the same time that it controlled movement of wealth and other commodities.

Settlement structure likely had as much or more to do with animal husbandry, agriculture, and craft practices, and perhaps the division of labor of these practices, or the division between

crop and livestock farmers, between tell and off tell sites along lineages or clans, as it did with potential elite authority and positioning on trade routes (e.g. Bartelheim 2009). The tell at Százhalombatta-Földvár was already established and fortified by the EBA so an active elite choice of this site for control of metal flows in the MBA is debatable. There seems to be a continued strong emphasis upon community and the collective with little variance in house size or evidence for craft specialization. Though Earle and Kolb (2010) and Artursson (2010) claim that the fortified sites should not be overemphasized, they assert at the same time that the positioning of apparently fortified sites along the Danube to control trade was precisely why the Benta Valley polity developed. While the fortifications and settlement patterns have been theorized to directly relate to organization for chiefly control in the Benta Valley, this is not considered to be the case in the other MBA contemporaneous cultural regions (Duffy 2010, 2015; Fischl et al. 2015; Szeverényi and Kulcsár 2012).

Ceramic production was of a high quality and quite localized to each cultural region and generally similar within regions, but a number of imports from adjacent cultures are present (Earle et al. 2011; Kiss and Fischl 2015; Kreiter 2007, 2012; Kreiter et al. 2007). Cross-regional exchange in pottery was common. In the Benta Valley, ceramic traditions were stable for over a thousand years and no orientation for exchange beyond the local or regional groups was found, even though some craft specialization in pottery production is assumed (Earle et al. 2011). Many potters practiced all over the various sized settlements and production was apparently not specialized elsewhere in the MBA of Hungary (Duffy 2010; Kienlin 2012; Michelaki 2008; Nicodemus 2014).

Households do not show a terrible amount of size differentiation in the various regional cultural traditions. At Százhalombatta-Földvár, “the Hungarian case study had densely occupied

settlements, which appear to have little evidence of differentiation among dwellings and apparently little internal hierarchical organization” (Sørensen 2010:123). House sizes do vary some in the Vatya of Százhalombatta, and some households have evidence of ritual horse head and hoof deposits, caches of bits (Chapters 5 and 6), and finer ceramic wares (Vicze 2013). There is not much other evidence for exclusively elite households in the tell culture traditions: no households had better quality or more material goods than any other nor did they have evidence for more or better meat or cereal products (Kienlin 2012). There is some differentiation for particular craft production in the Füzesabony where households apparently varied by metal work, stone tool making, bone and antler processing, and ceramic production (Jockenhövel 1996).

Burial rites vary between the tell cultures from the formalized cemeteries and distinct clusters of inurned cremations in the Vatya, scattered and inurned cremation with the Transdanubian Encrusted Pottery Ware, to the large formal inhumation cemeteries arranged in groups in the Füzesabony and Maros (Csányi 2003a; Polanyi 2010; Vicze 2011). The Gyulavarsánd maintain a larger variety of practices including inhumation and urn and scattered cremation (Fischl et al. 2015). While the body is treated differently in different cultural areas, grave goods were given in a similar manner across the tell cultures. In a comparison of MBA burial practices, Sørensen and Rebay (2008) found between 5-20% of the Vatya population buried with bronze, 10% of the Encrusted Pottery Ware people interred with it, while the Füzesabony were noted to have been frequently buried with bronze weapons and jewelry. Women were generally buried with bronze jewelry and men with bronze weapons.

The presence of social differentiation has been inferred from the around 5% of the Vatya burials at Dunaújváros-Dunadűlő that contain bronze weapons and jewelry and the richly furnished

male burials with complete armament and women with ostentatious bronze necklaces and clothing trims (Earle et al. 2015; Earle and Kristiansen 2010; Sørensen and Rebay-Salisbury 2008; Vicze 2011). With the large Füzesabony inhumation cemetery at Tiszafüred-Majoroshalom, there were burials of men with a warrior's complement of weapons and women with fancy jewelry and clothing trims (Kovács 1992). Physical anthropological analyses indicate that there was continuity of populations in the MBA, meaning that there were less external people coming into the Carpathian Basin in appreciable numbers at this time (Zoffmann 2000).

As with horses, bronze was already present in the Danube-Tisza region by 2500 BC, an import from the Balkans and the Pontic steppes (Pare 2000). Metal ores were locally unavailable and had to be ascertained via trade from the Eastern Alps and Upper Hungary. Trade routes that secured the appropriate tin and antimony assured that classic 4-10% tin bronzes became the norm after 2000 BC, between 1800 and 1700 BC. Despite a focus on metal procurement in explanatory models of Bronze Age development, "the ephemeral nature of metallurgy-related evidence there is little indication that it differed in scale and importance from other such 'crafts' or occupations" (Kienlin 2012:289). But the overall quantity, quality, and rarity of metal weapons, jewelry, and tools increased significantly (Fischl et al. 2015). The most famous MBA metal finds were recovered from 323 bronze and 32 gold hoards as well as burials in the Danube-Tisza Basin (David 2002). There are two large groupings of bronze hoards (discussed more in the next sections) defined spatially and compositionally that date between 1800 and 1600 BC: the Tonanémdi (west of the Danube, mostly jewelry present) and the Hajdúsámsori (Danube-Tisza basin, more weapons and gold objects) (Mozsolics 1967; Bóna 1975; Honti and Kiss 2000).

Metallurgy was widely practiced at many different kinds of settlements: from apparent workshops at the Vatin tell of Mošorin-Feudvar (Hänsel and Medović 2004) and the Vatya tell of Lovasberenény-Mihályvár (Petres and Bándi 1969) to obscure off tell hamlets, and thus does not appear to be confined either to tell settlements or full time specialists (Duffy 2010; Kienlin 2012; Sofaer et al. 2010; Quinn 2017).

> Interestingly, despite the frequent emphasis on metal technology in BA social models…our work has revealed little direct evidence for metalworking. At Százhalombatta, fragments of bronze, moulds, and slag attest to metalworking from the EBA (Horváth, Kozák, and Pető 2001; Poroszlai 2000; Sørensen and Vicze 2013), but are relatively few. With little substantial to add to knowledge about metal technology, we do not consider it here (Sofaer et al. 2010:185–186).

However, the flow of bronze in raw materials and finished products has been widely theorized as the main impetus for the emergence of political economies, the development of complex regional polities, and the institutionalization of social stratification because the flows of these commodities could be bottlenecked and controlled by ambitious elites at strategically positioned tells (Earle et al. 2015; Earle and Kristiansen 2010; Kristiansen and Larsson 2005). With the control of metals, a hypothesized warrior elite emerged. Save burials, the lack of obvious elite control over metals from archaeological contexts, such as from households or special buildings, poses a problem. The location of tells along the Danube and Tisza has been used to substantiate that their orientation was towards the metal trade, as has the discovery of an apparent settlement hierarchy in the Benta Valley and elsewhere (Earle and Kolb 2010:84–86; Earle and Kristiansen 2010:242–245; O'Shea and Nicodemus 2017; Nicodemus 2014; Sherratt 1993).

The majority of the sites where the large tell villages were established in the MBA were chosen in the EBA, and apparently with respect to the agricultural productivity of the landscape. Earle and Kolb (2010) argue that at Százhalombatta, the Danube truncated the catchment area, so

the choice of site for the tell had to be a strategic one for trade. This assumes that the catchment area must be roughly circular and calculated for pedestrians, not mounted herders. It also ignores the mitigating choices stockbreeders make when choosing appropriate sites for settlement, such as a high place with natural borders for safety and to keep watch and proximity to the most productive pastures which leads to less herding at a distance. Despite the presence of the Danube ‘truncating’ potential catchment, its choice for Bronze Age stockbreeders does make much pragmatic sense. The EBA fortification ditch may even have originally been made to keep livestock in the area of the early tell village at night (Parkinson and Duffy 2007).

On the other hand, the rivers adjacent to the tell settlements do provide access to trade routes and there was an undeniable florescence of bronze craft during the MBA, especially during the late MBA, the Koszider Period (1600-1500/1450 BC) (Fischl et al. 2013), discussed further in the next section. A proliferation of extremely fine and decorated bronze swords and axes were found in the hoards and some burials in the MBA. They were in fact decorated with similar motifs to the horse bits and their stylistic distribution spans from Sweden to Italy (David 2007; Hüttel 1981; Kristiansen and Larsson 2005:181–185, Figures 77, 78, 79). The inconclusive nature of metallurgical finds from settlements demonstrably related to an emergent elite coupled against the obvious development of highly evolved related bronze weapons and horse bits leads me to the animal husbandry and the horse bones from the MBA to try to tease out some answers. Earle and Kristiansen (2010:244) acknowledge the importance of agricultural surplus of the Benta Valley as the staple finance that made possible the wealth finance of international trade. As “No plant remains suggest distance trade, emphasizing local production, much for household use” livestock and livestock products were the only like source of highly valuable items of exchange (Vretemark

2010:182). In order for there to be trade and control in metals, *something*, has to be demonstrably evident as the item of value for which metal can be traded (Quinn 2017; Quinn and Ciugudean 2018). Analysis of the faunal remains can give us an idea if a critical potential surplus of animal products was oriented for exchange.

Environmentally, the MBA was ideal for animal husbandry and is contemporaneous with the middle Sub-Boreal phase and marks a transition to a warmer and drier climate between 2000 BC and 1500/1450 BC (Sümegi and Bodor 2005). The Carpathian Basin had a mosaic pattern of climactic zones and regional differences in landscapes (Sümegi and Bodor 2000). Site choice in the EBA for both agricultural productivity and access to trade routes had impacts on regional divergent ways complexity developed (Bartelheim 2009; Duffy 2010; Quinn and Ciugudean 2018). The overwhelming majority of EBA to MBA settlements, tell and off tell sites, were located on prime agricultural land and loess soils.

"The Early-Middle Bronze Age witnessed a lengthy period of stable grassland conditions associated with animal husbandry" (French 2010:43). Stockbreeding retained primacy over crop agriculture, but the latter was practiced in every area (Bökönyi 1988a; Harding 2000; Sümegi, Kertész, and Hertelendi 2002). Crops include einkorn and emmer wheat, barley, oat, rye, millet, bean, lentil, pea, apple, elderberry, blackberry, cornel-cherry, cucumber, mustard seed and the hay (or fodder) crops of oat and clover (Gyulai 1993; Vretemark 2010). Many of these crops, especially emmer and barley, were documented to also feed to animals from the Bronze Age of the Near East (Riehl et al. 2013). Animal husbandry with regimes of crop agriculture was probably the general occupation of most people, and was the economic and social backbone of these communities and households, while pottery, metallurgy, and tool manufacture was also of importance. While pits

for threshed wheat have been found at Százhalombatta-Földvár, central granaries are absent from the tells which raises questions regarding how crop agriculture was practiced, e.g. at the household or community level, and how agricultural products were distributed (Porloszlai 2003; Csányi and Tárnoki 2003). Each of the houses excavated at Százhalombatta (Vatya) and Túrkeve-Terehalom (Gyulavársand) show evidence of grain processing for cooking (Stig-Sørensen 2010), but no evidence for exchange or surplus production (Vretemark 2010). Sümegi (2013) found in the Kenderföld (SW Hungary), that land selected for crops was in subordinate proportions to pasturelands and placed in plots around them. The situation was likely the same in the Benta, where, "The implication is for long-term sympathetic land management practices within the Early-Middle Bronze Age in this region, with a predominance of grassland for grazing over intense arable cropping" (French 2010:55–56).

Animal husbandry predominated the EBA, but the MBA marked significant overall increases in all animals and changes of the relative frequencies of domesticated animals (Bökönyi 1974; Choyke 1984; Choyke et al. 2004). At Százhalombatta-Földvár (Figure 4.4 and 4.5) and the Benta Valley (Figure 4.6), cattle decreased and sheep increased, while they both show demographic shifts to their secondary products, e.g. sheep for wool and cattle for dairy and traction (Vretemark 2010; Vretemark and Sten 2005). Choyke, Vretemark and Sten (2000, 2004, 2010, 2005) performed all of the analyses of the fauna at Százhalombatta-Földvár while I examined the fauna from the Benta Valley surface collections and cubits (test pits) in 2006 and 2007.

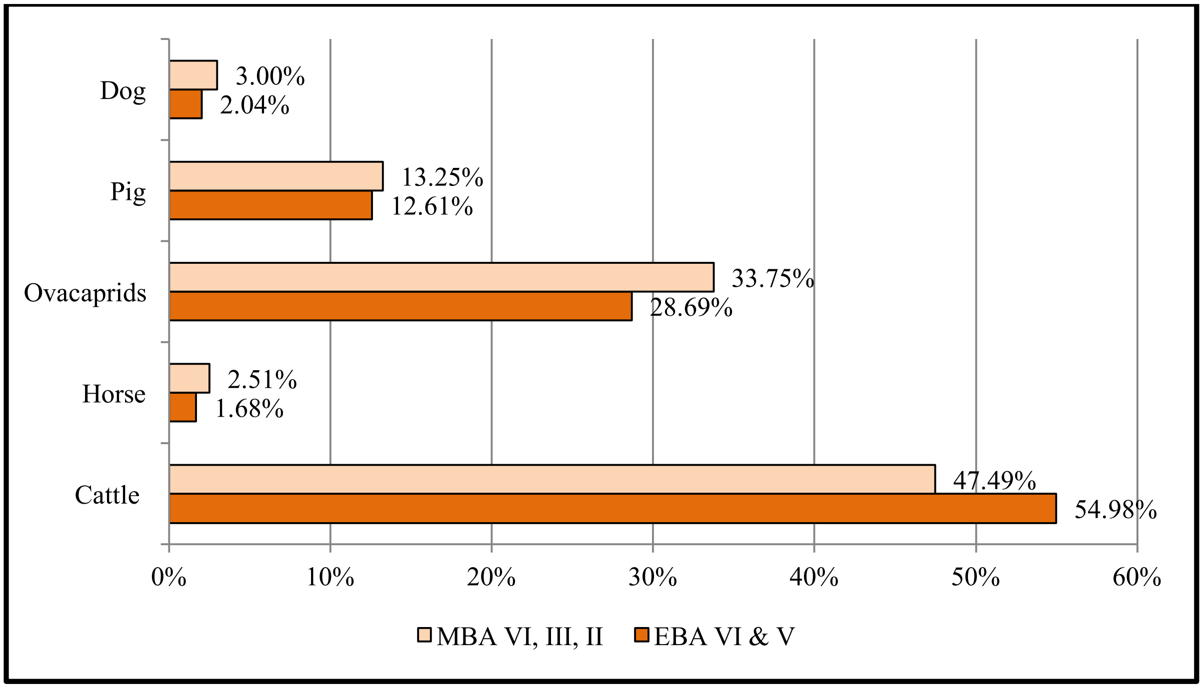

Figure 4.3. Relative Frequencies of Domesticated Animals from EBA to MBA at Százhalombatta-Földvár in NISP % (Vretemark and Sten 2005).

Cattle were slaughtered much later in life and show evidence of being harnessed to pull wagons and plows (Vretemark and Sten 2005). Most (nearly 70%) of cattle were kept until 3 years (maturity) or greater, with many surviving into old age, while about 30% of cattle (mostly young males) were slaughtered (Figure 4.4). Cows and heifers (females under 3 years old) were dominant, implying dairying, but 1/3 of adult cattle were male and both sexes showed evidence of draught induced pathologies (Vretemark 2010:165).

While sheep and goats are difficult to differentiation osteologically, where possible, sheep were far more dominant than goats at Százhalombatta-Földvár (Vretemark and Sten 2005:166). Sheep kill-off patterns skewed dramatically to older animals in the MBA, where about 60% were kept as adults and one-third were rams or wethers (neutered rams), which indicates a breeding population because otherwise there is little need to keep such a large number of adult males (Figure

4.4). There were also clay loom weights for spinning and weaving wool found in houses at Százhalombatta-Földvár, which somewhat furthers the case for the development of wool production in the MBA. However, these were very rare and suggest limited production weaving (Sofaer et al. 2010:196). The abundance of this material has been overestimated recently in proveniencing Nordic Bronze Age woolen textiles, “Wool production in Central Europe probably started with the rise of Bronze Age political economies; for example, at Szazhalombatta in Hungary, where large quantities of textile tools and sheep bones have been recovered from Bronze Age layers (Vretemark 2010: figs 6.4 & 6.5)” (Frei et al. 2017:648). Pigs were kept for meat, as most were slaughtered as juveniles and the sex ratios were roughly even (Figure 4.4). As cattle production for meat decreased in the MBA, swine increased as pork was traded for beef.

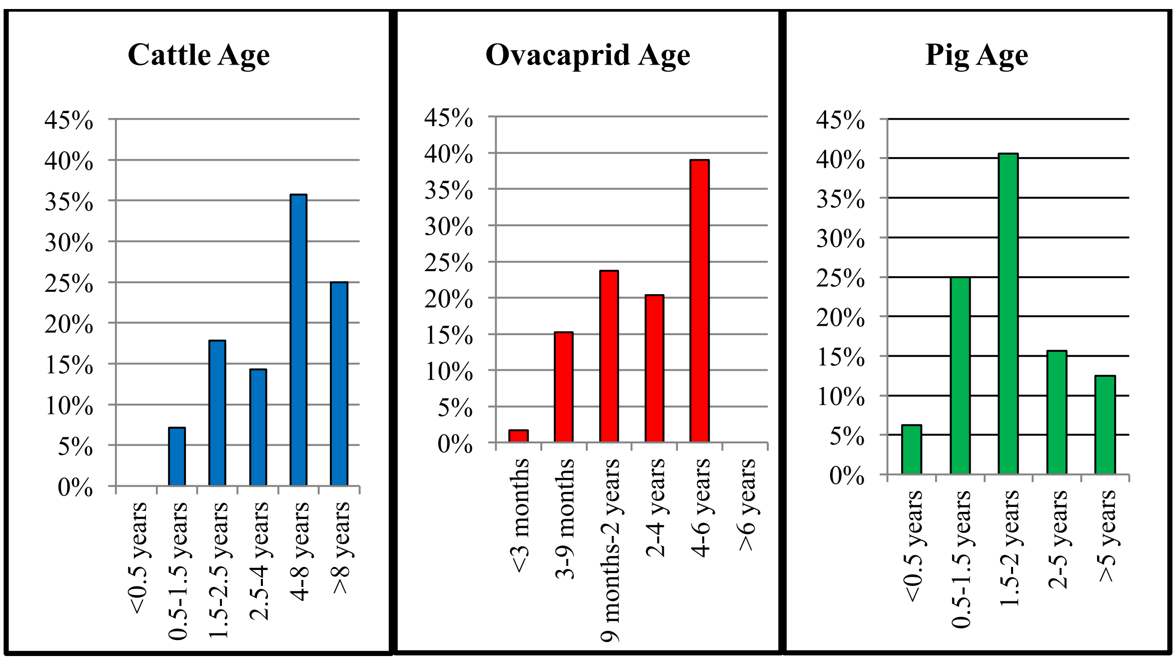

Figure 4.4. Age Classes of Cattle, Sheep, and Swine at Százhalombatta-Földvár.

Vretemark (2010:169) estimated that a yearly living stock would be around 680 animals (180 cattle, 320 sheep, and 180 pigs) just for meat with another 2500 sheep just for wool. Based on the faunal assemblage, there should be about 20 horses added to this per year, not estimated for meat. “This requires large-scale animal husbandry and a living stock of several thousands of animals” only for the people living at Százhalombatta-Földvár. The grazing requirements per hectare for cattle and horses are 1:0.8ha, sheep is 1:0.085 ha, pigs are 1:0.05ha (Allen, Heitschmidt, and Sollenberger 2007; Sollenberger et al. 2012). This means that roughly about 200 ha of land needed for a yearly coterie of livestock for all 1700 people of the Benta Valley polity, with an additional 200 ha of land for the 2500 wool sheep. Given the polity size is 50 km^2 (Earle and Kolb 2010:83), this is well within the amount of land available. As the size of MBA Százhalombatta-Földvár was 5.5 ha, off-tell grazing, and grazing outside of the off-tell settlements was likely, with daily rounds of taking animals to graze or monitoring of defined pastures. Doing so on horseback would have made much sense.

In the Benta Valley, the off tell sites have much more cattle overall than the tell sites in the MBA, while sheep/goats (ovacaprids) are less numerous and pigs are relatively the same (Figure 4.5). Does this mean that the valuable wool sheep were kept in or close to the tell, while the dairy and traction animals were kept more often at off-tell settlements?

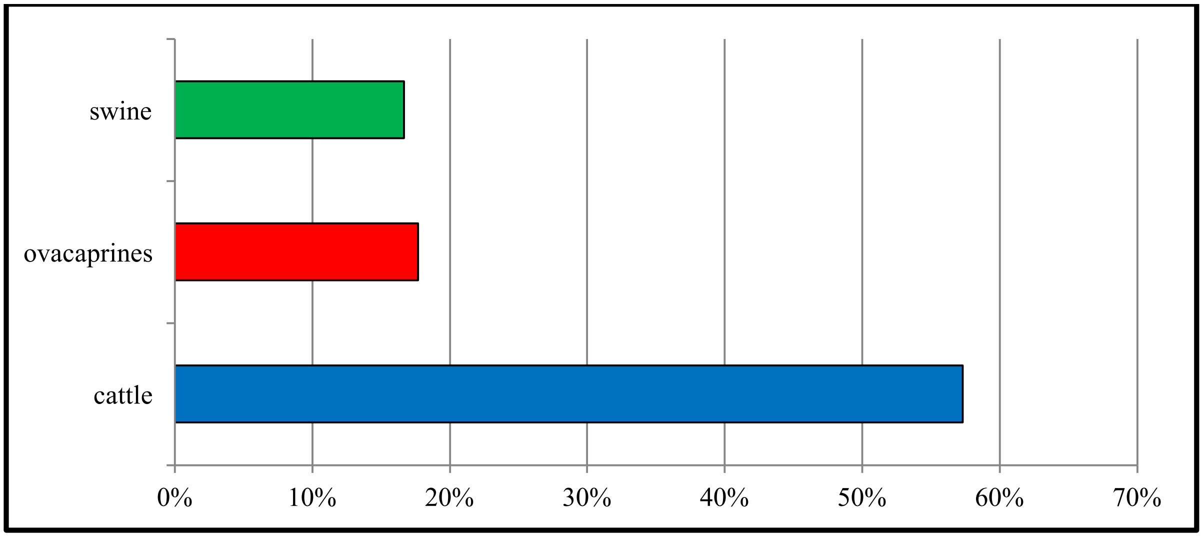

Figure 4.5. Relative Frequencies of Swine, Cattle, and Ovacaprids in NISP % in MBA Benta Valley.

The off-tell residents may have provisioned the tell populations with meat. Prime aged meat animals were generally missing from off-tell settlements (Figure 4.6). In the Benta Valley, there were no 2-5-year-old pigs, no 3-9 month old ovacaprids, and no 0.5-1.5-year-old and 2.5-4-year-old cattle recovered. Despite some reference that suggest animals arrived at the tell as ‘ready cuts of meat’, (Earle and Kristiansen 2010) the body part distribution both on and off the tell indicates that animals were slaughtered, butchered, and consumed within the habitation site (Vretemark 2010:169; Vretemark and Sten 2005:4). It is not clear if this pattern was repeated in other regions, or if it is more related to butchering practices as opposed to meat provisioning. The off-tell settlements did not contain the missing body part elements that should be in place if the animals were slaughtered away and then brought to the tell as various cuts of meat. However, the only available systematic zooarchaeological study of off-tell animal husbandry was my own, and it was made from surface finds and test excavations.

Comparatively, animal husbandry traditions were not uniform either across or within the MBA tell cultures of Hungary and reflected the characteristics of different landscapes, settlement arrangements, and productive goals (Figures 4.7 and 4.8). In examining three tells from the EBA to the MBA, the changes between EBA/MBA seen at Százhalombatta-Földvár were not seen across MBA Hungary. At the Vatya tell settlement of Igar-Vámpuszta, there was no appreciable difference between cattle, ovacaprid, and swine frequencies from the EBA to the MBA (Choyke and Bartosiewicz 1999). The Füzesabony tell of Jászdózsa-Kápolnahalom shows an opposite trend from the EBA to the MBA in cattle, sheep, and swine from Százhalombatta-Földvár; cattle actually increased significantly at Jászdószsa-Kápolnahalom in the MBA, while sheep and swine decreased (Choyke 1984).

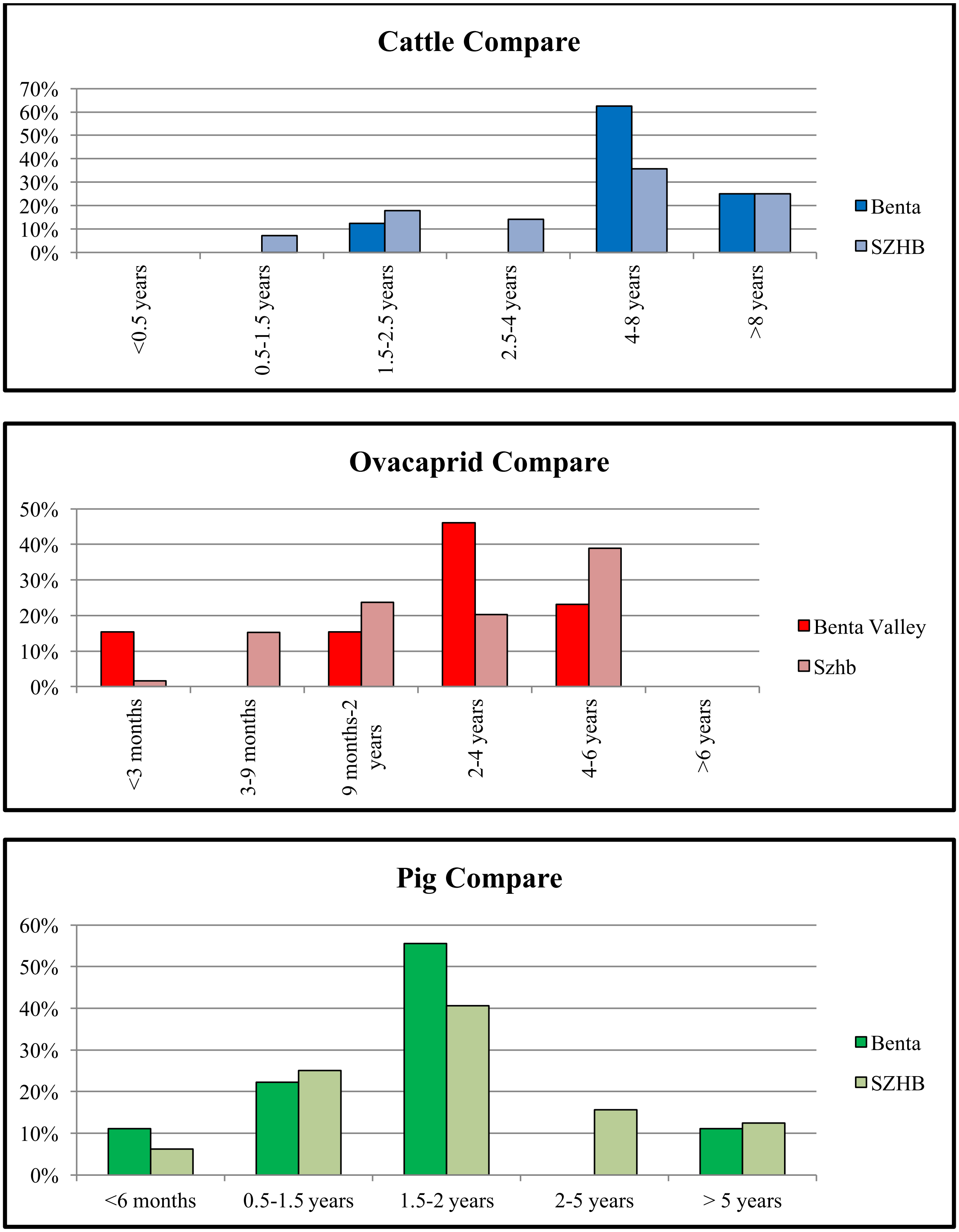

Figure 4.6. Comparative Age Distributions of Benta Valley Off Tell Animals.

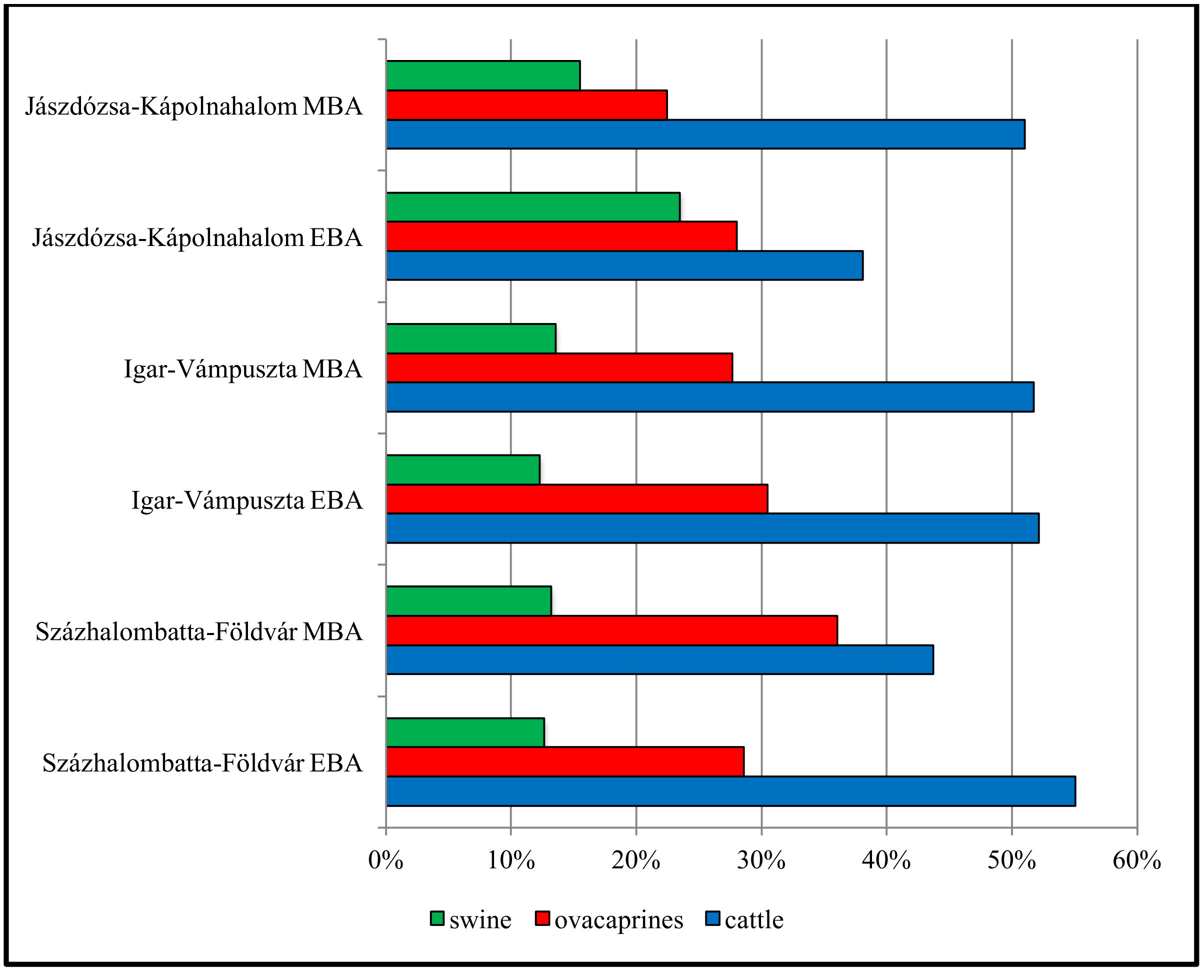

Figure 4.7. Comparative Relative Frequencies of Domesticated Fauna from three Tell Settlements from the EBA to the MBA in NISP %.

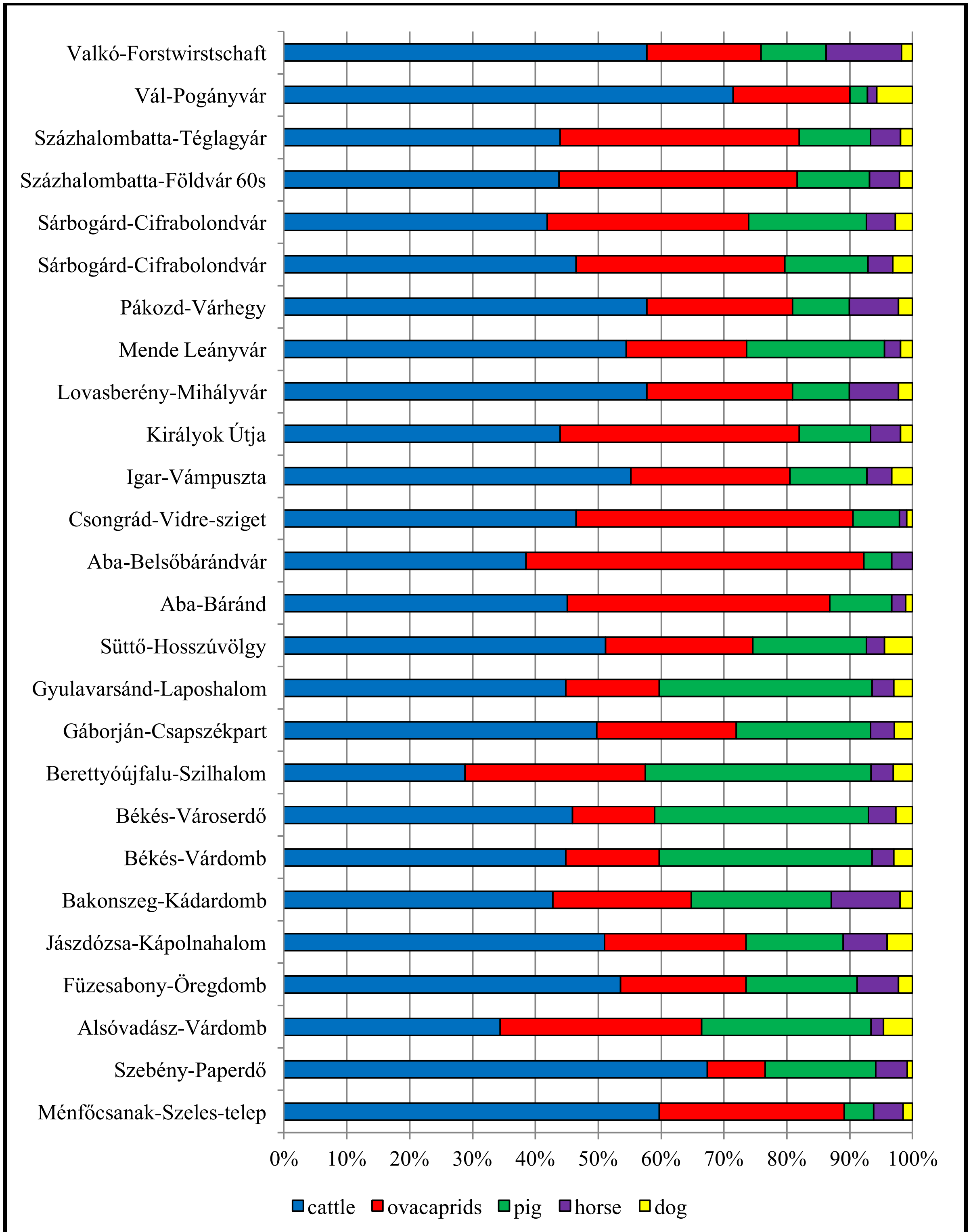

Figure 4.8. MBA Relative Frequencies of Domesticated Animals at Tell Settlements in NSIP %.

Within each tell cultural region, animal husbandry was quite heterogeneous. Vatya settlements range wildly on the amount of cattle to ovacaprids they have from 71% cattle and 18% ovacaprids at Vál-Pogányvár to 38% cattle and 54% ovacaprids at Aba-Belsőbárándvár. Pigs range from to 22% of the faunal assemblage at Mende-Leányvár to 3% at Vál-Pogányvár. These sites aren't outliers in terms of their production strategies. Rather, they show the incredible variability of animal husbandry at Vatya tells (Figure 4.8). Füzesabony tells range from 54-34% cattle, 20-32% ovacaprids, and 15-27% swine. The Gyularvarsánd tells do consistently have the highest number of pigs in the MBA, but there is some variance between them in their assemblages. Two of the Gyularvarsánd tells in the Berettyó Valley, Bakonszeg-Kádárdomb and Gáborján-Csapszékpart have roughly similar domestic faunal assemblages while nearby Berettyóújfalu-Szilhalom is really different with a lot more pigs and less sheep and cattle (Bökönyi 1988a). The people of the Encrusted Pottery Ware culture show a high preference for cattle, very few ovacaprids, and more pigs at Szebény-Paperdő, while at Ménfőcsanak-Szeles-telep they have a high number cattle, a goodly amount of sheep, and very few pigs (Choyke and Bartosiewicz 1999).

Dogs were consistently present on all the MBA tells (Bökönyi 1959; 1974; 1988; Choyke 1984; Choyke et al. 2004; Vretemark 2010; Vretemark and Sten 2005, 2010) (Figure 4.9). They probably were guardians, herders, and pets and they appear to have a special status among domesticates like horses. They were often buried, are represented in the faunal assemblage by a predominance of whole skulls and cranial fragments, and their teeth were used for necklaces (Choyke 2005b; Vretemark and Sten 2010).

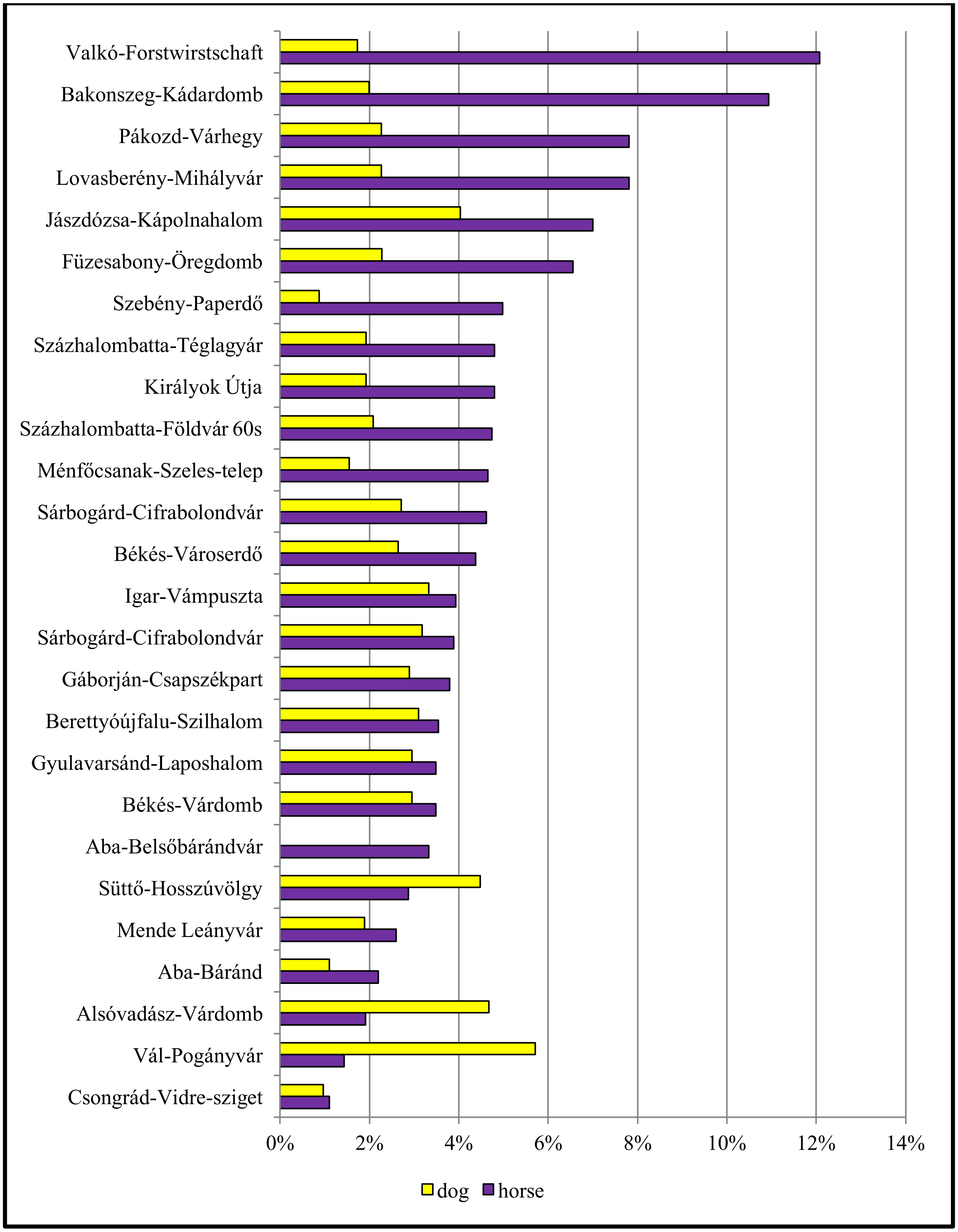

Figure 4.9. Relative Frequencies of Horses and Dogs at MBA Tell Settlements.

Hunted wild animals have been recovered from all of the MBA tell settlements, and there was a special appreciation for red deer at sites like Jászdósza-Kápolnahalom, where there are ritual deposits of stags (Choyke 2005b). Eastern Vatya and Füzesabony tell sites generally consumed more game as opposed to Vatya sites (Choyke et al. 2004). Bone and antler tools are frequent and will be discussed in the next chapter (Chapter 5) in the context of the antler horse bits, as a number of worked bone is horse.

With regard to livestock exploitation for secondary products and surplus at MBA tell settlements, there is considerable variance. In the Maros, MBA animal husbandry is a mixed meat and secondary products affair with no obvious orientation towards a specialization in any secondary product (Duffy 2010). At the Berettyó Valley tells, as at Százhalombatta-Földvár, a majority of cattle and survived into adulthood, suggesting they were exploited for their secondary products, dairy and traction and wool respectively, along with their meat value (Bökönyi 1988a:127). Quite unusually, these Gyulavarsánd tell settlements also had a majority of pigs surviving into adulthood. Swine production was possibly oriented towards surplus production for trade in other commodities at the Gyularvarsánd tells.

Along with the strong regional and intra-regional differentiation in craft and metallurgical production, all of the heterogeneity in animal husbandry suggests strong regional, intra-regional, and even intra-polity variability in animal production goals. There was not a single uniform way people oriented their animal production towards surplus exchange, if they did at all. These factors substantiate "a trend in Bronze Age archaeology which notes that the wider European continent was a mosaic of societies with different forms of complexity following different trajectories of socio-economic change" (Quinn and Ciugudean 2018:1), as opposed to a more homogeneous

conception of the tell building economies (Kristiansen and Larsson 2005). There were notable cases of the potential development of a surplus production of wool in the Vatya Benta Valley (Vretemark 2010) and swine in the Gyularvarsánd Berettyó Valley. Does horse husbandry have a similar orientation or intensification in the MBA?

Horses in the MBA expanded in both locations and numbers with the tell building cultures (Figures 4.10 and 4.11). Despite often being dismissed as low amounts of the faunal assemblages, horses from the MBA tell sites are represented by *higher* HRC levels and levels within the range of other known equestrian populations in Hungary who demonstrably relied on and fought on horses, like the Early Iron Age Prescythian, Scythian, and Celtic peoples, where HRC averages 5.56, 17.3, and 10.04 respectively from similarly sized faunal assemblages (Bartosiewicz and Gál 2010). Vatya sites have an average of 8.31 HRC, Gyulavarsánd 10.26 HRC, Füzesabony 9.41 HRC, and the Encrusted Pottery Cultures have 7.06 HRC.

The picture differs from EBA horse amounts where the Bell Beakers had a monopolizing 42.15 HRC average, then the Nagyrév sites clustered together with a high 16.34 HRC average, while only one site each of Nyírseg, Hatvan, and Máko cultural regions even approached Nagyrév HRC averages. This could mean that horse husbandry initially spread to a single settlement within each cultural region, maybe the central village of an emergent EBA polity. The distribution is more even among MBA tell settlements, with the Gyularvarsánd tell of Bakonszeg-Kádardomb an exception. All of these MBA tell settlements have appreciable numbers of horses by the MBA, and all horse numbers in this period are within the range of other cultures from later periods with known equestrian traditions. There were more than enough horses for people to be equestrian specialists in the EBA and MBA of Hungary.

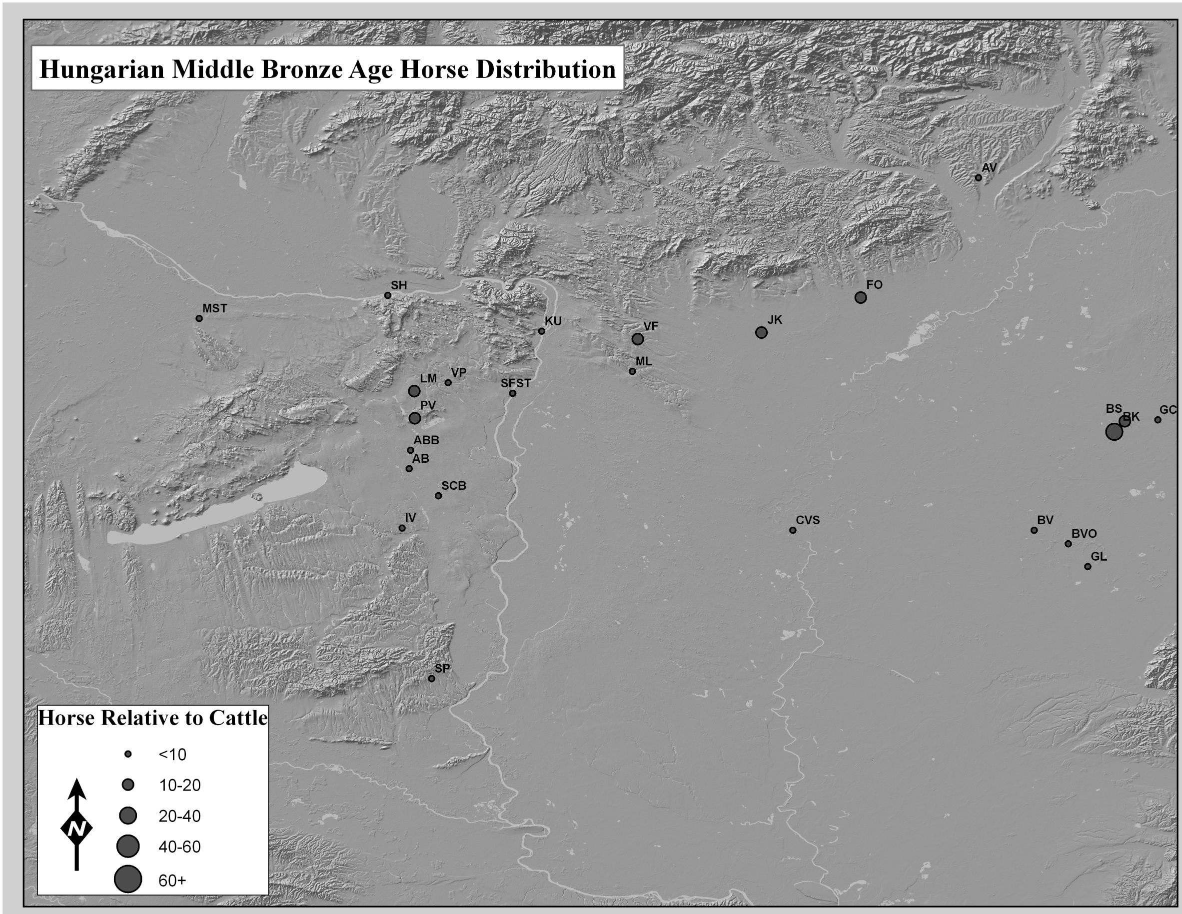

Figure 4.10. Map of MBA Horse Distribution in HRC.

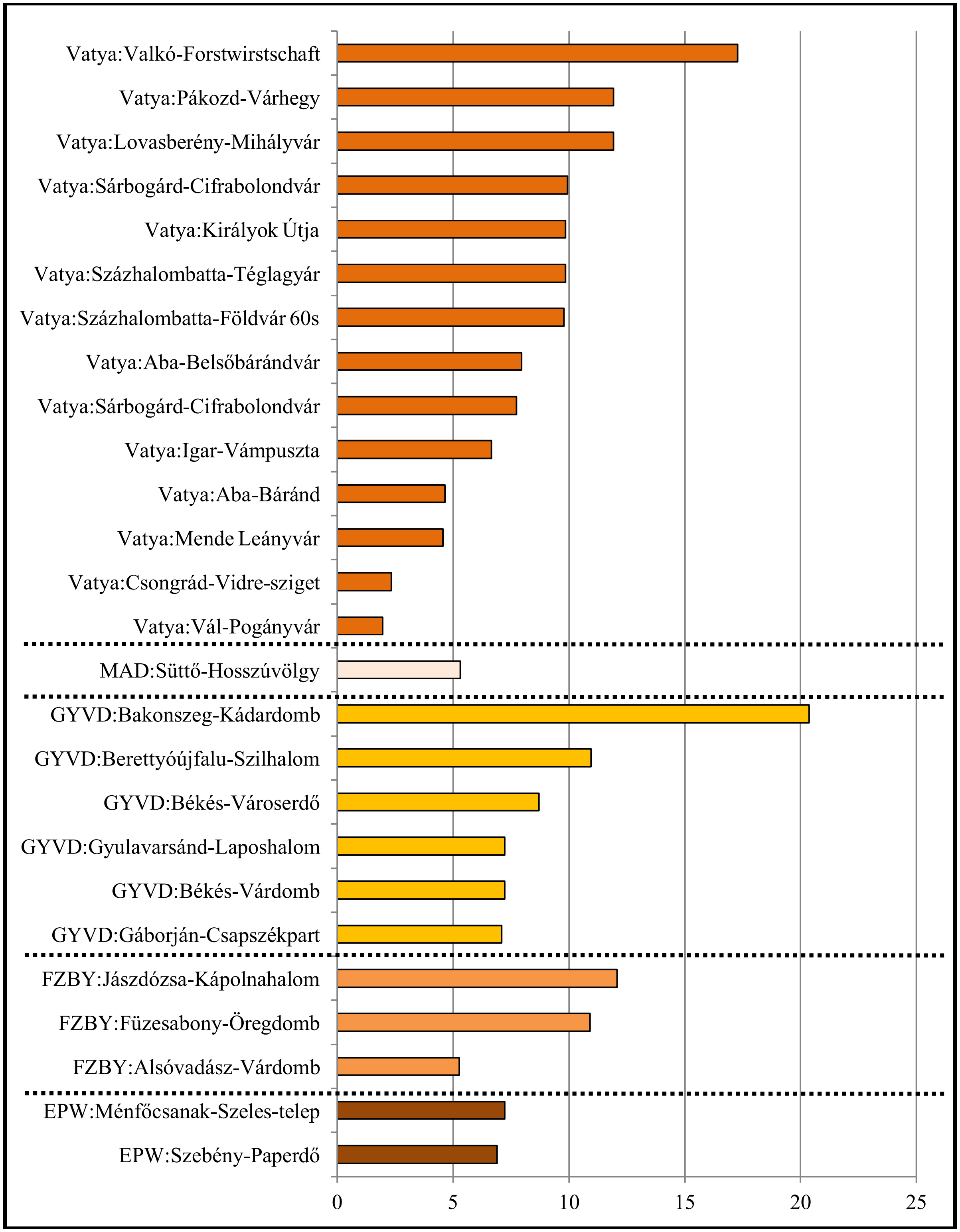

Figure 4.11. MBA Horses in HRC at Settlements in Hungary by Cultural Region.

Horse bit finds may also indicate a specialization in horse husbandry and equestrianism in Bronze Age Hungary. The Hungarian Bronze Age bits were first of their type and are completely idiosyncratic to the region and the period. In the MBA 76 bits were found (Figure 4.12), up from 13 dated to the EBA, though dating to periods in the Bronze Age is complicated (Bökönyi 1953; Bándi 1963; Choyke 1984; Hüttel 1981; Mozsolics 1953) (Chapter 6). Bits have been found at many tell settlements in Hungary during the MBA (Figure 4.13), except among the Encrusted Pottery Ware peoples.

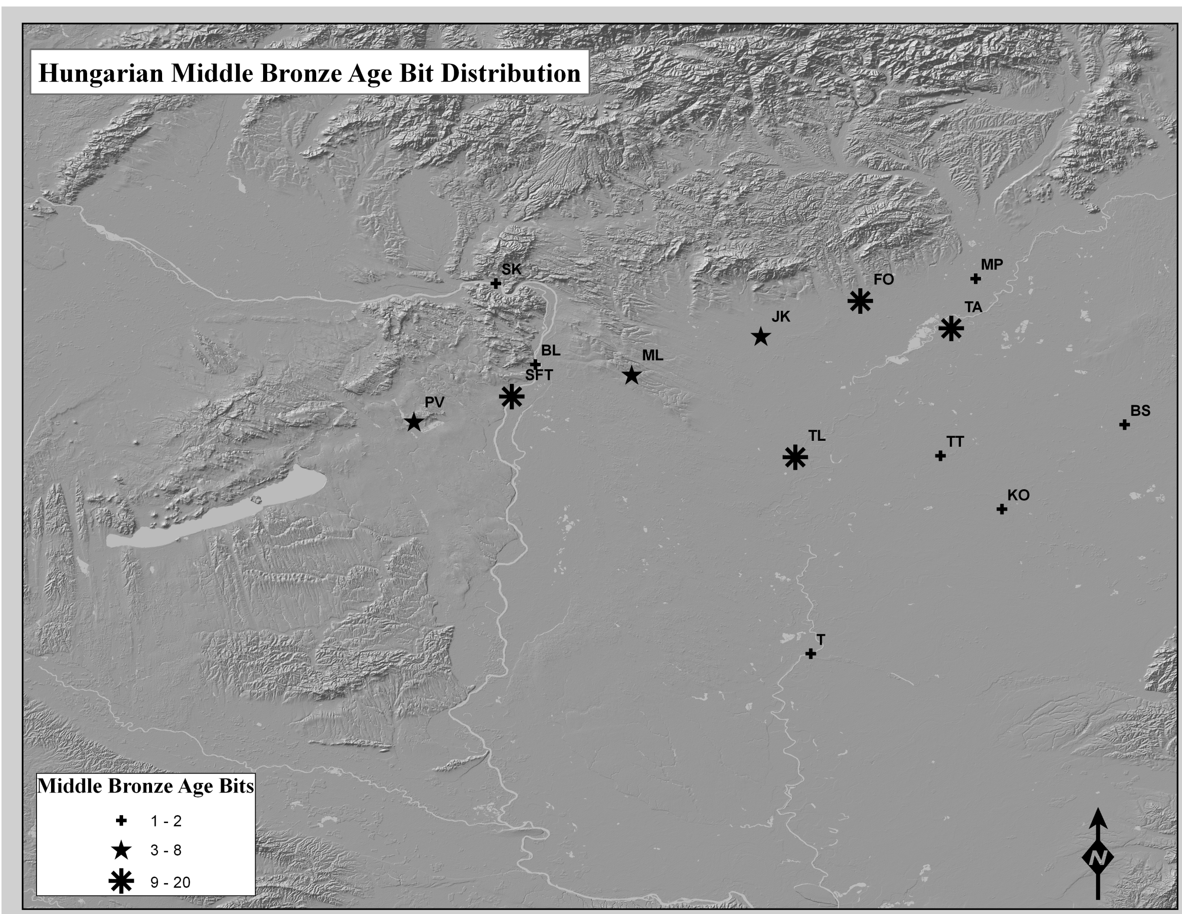

Figure 4.12. Map of MBA Bit Distribution.

Figure 4.13 highlights the Füzesabony (51 bits, 67%) and the Vatya (22 bits, 29%) may be focusing more on horse husbandry than the other regions.

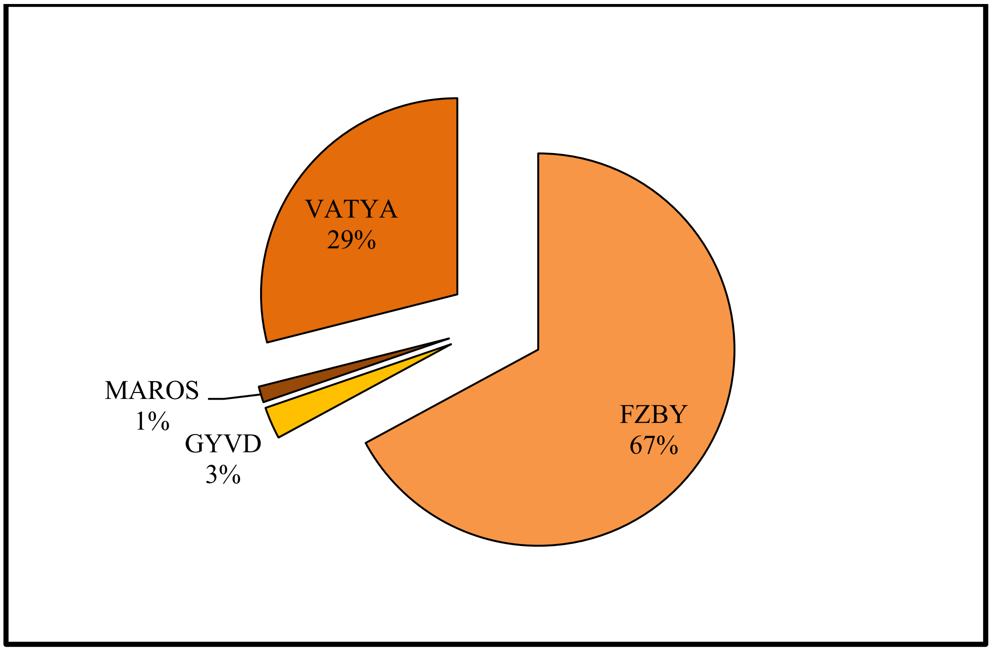

Figure 4.13. MBA Bit Distribution by Culture.

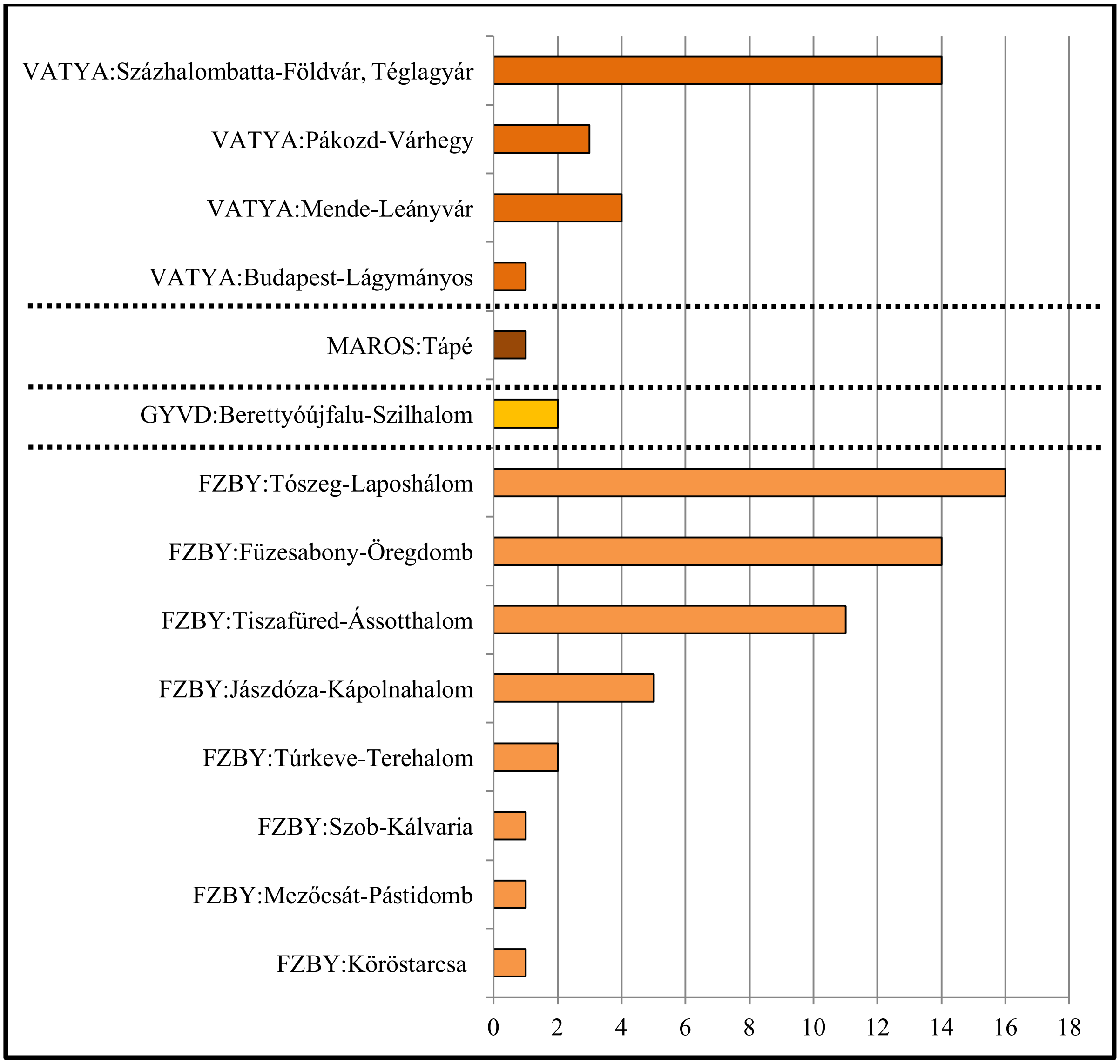

Figure 4.14. MBA Bit Distribution by Tell Settlements.

As with the other fauna, determining the age of horses at death permits the construction of age class profiles for archaeological sites (Levine 1982; Reitz and Wing 2008). Age classes are also one way to assess if and what kind of specialized horse production may have occurred at different settlements. Age of horses in archaeological specimens is principally determined by the length of premolar and molar teeth, but can also be indicated by the shape and appearance of the

incisors and by ephiphyseal fusion (Martin 2010; Grant 1982; Evans et al. 1994; Levine 1982; Lyman 1994). Horse teeth grow throughout an individual animal's life at a known rate, so as archaeological specimens, they can be measured, and these measurements are used in turn to determine age classes. I used Levine's (1982) method for measuring premolars and molars to determine age classes and supplemented this with the diagnostic criteria set forth by the American Association of Equine Practitioners (Martin 2010) for determining age by the shape and appearance of the incisors when only incisors were available.

Within the MBA polity of Százhalombatta-Földvár, in the Vatya settlements of the Benta Valley, horses were largely missing from off-tell settlements based on my assessment of the Benta Valley Survey finds from surface distributions and test excavations. Only degraded teeth from three younger horses were found at off-tell settlements. At Százhalombatta-Földvár, an entire breeding population was represented. This could imply that horses were bred off the tells and then returned to people on them for training as they reached maturity, or that horse teeth were perhaps curated for use as pendants as has been found at other MBA tell settlements (Choyke 2005b).

Just north of the Benta Valley polity, the Vatya settlement of Kiralyók-Útja 293 is located in Budapest at the apex of a now dry riverbed running SE to NW like the Benta. Overall numbers of horses are similar to the distribution at Százhalombatta-Földvar, 218 NISP and 13 MNI at Kiralyók and 247 NISP and 15 MNI at Százhalombatta-Földvár, but the age class distribution is strikingly different (Figure 4.15).

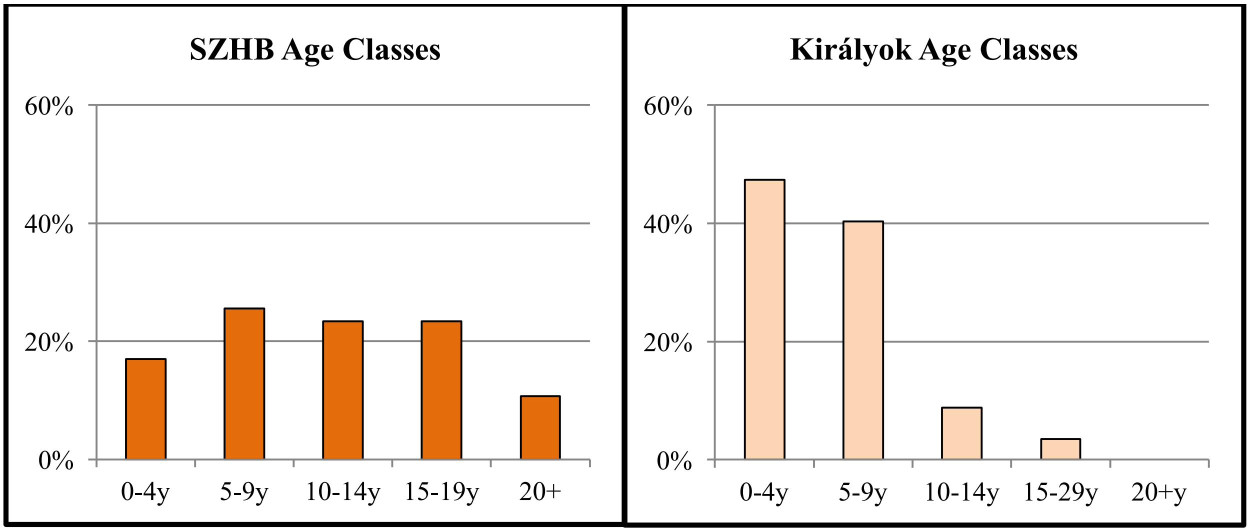

Figure 4.15. Age Classes of MBA Horses at Százhalombatta-Földvár and Királyok-Útja 293.

Prime aged using horses, 0-9 years of age, are overrepresented at Királyok. Training of young horses can begin at birth, but horses are typically intensively trained and put into work roughly at age 3 when their skeletal maturation reaches a level that can sustain active and repetitive use (Evans et al. 1994). Kikkuli, the famed Hurrian 'Master Horse Trainer' from the Mitanni, wrote c. 1400 BC of similar training ages (Kikkuli 1977). This age structure potentially represents a different orientation of horse production between these two Vatya settlements, perhaps polities. Horse breeding at Százhalombatta-Földvár may have been just for the strict use of their own horses by their own people, whereas at Kiralyók, breeding could have potentially concentrated on production for export. It also may have been that people at Százhalombatta-Földvár traded horses to the smaller settlement of Kiralyók, who then in turn shipped them farther north. Kiralyók is suspected to have been a Vatya tell like Százhalombatta and maybe the center of another complex regional polity, but millennia of occupation in Budapest clouds its interpretation (Szilas 2009). Either way, within the Vatya cultural region, horse husbandry practices varied considerably.

In the Gyularvarsánd tells of Berettyó Valley, at Gáboryán-Csapszekpárt, Berettyóújfalu-Szilhalom, and Bakonszeg-Kádardomb, there were larger numbers of horses overall expressed as HRC than in the Benta Valley. The age classes at the Berettyó Valley tells are also obviously different, where only adult horses are represented (Figure 4.16). This is probably indicative of the peoples at these tells obtaining horses as adults from other settlements outside their cultural region.

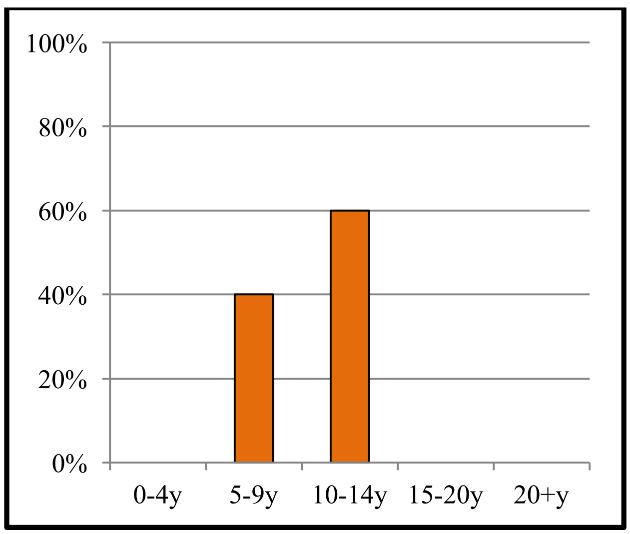

Figure 4.16. Age Classes Berretyó Valley MBA Tells Combined.

Clearly, horse husbandry and likely specialization varies between and within Vatya and Gyulavarsánd MBA settlements, and probably speaks to a divergence of political economic orientation or even use related differences. Of note here is the recent discovery of a major specialization and intensification of horse breeding at a Maros Culture tell in Romania, Pecica-*Şanţul Mare* (Nicodemus 2014). The incidence and prevalence of intensification and specialization in horse breeding and equestrianism is discussed further in the next chapter where the isotopic evidence is combined with the above demographic profiles and metric analysis of horse size at the withers is considered together.

Considering the horse bone and bit finds together may preview areas of specialized horse husbandry, where the Vatya and the Füzesabony have both good numbers of horses and bits, where the Gyularvarsánd only have adult horses and a few bits (Figure 4.17).

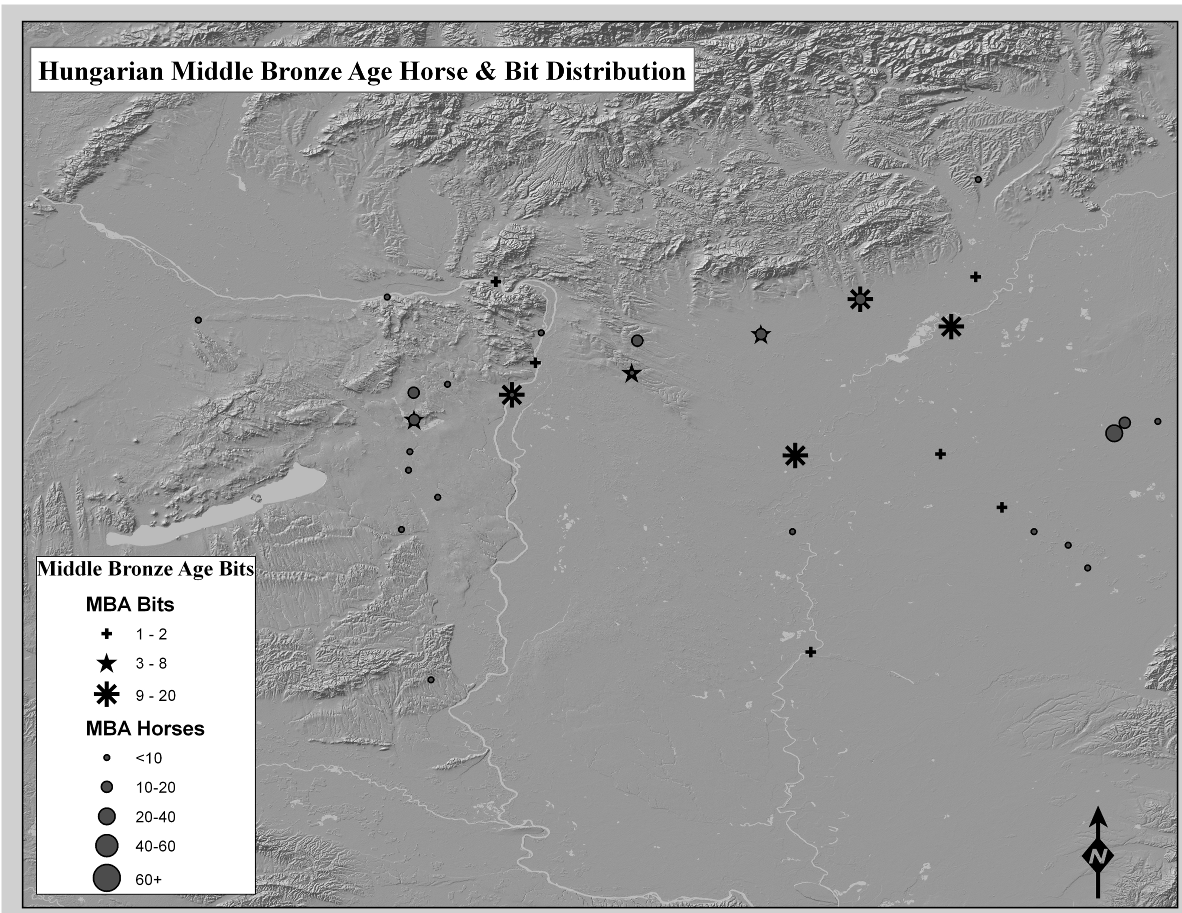

Figure 4.17. MBA Combined Horses in HRC and Bit Finds.

It looks as if there were two areas where horse husbandry and bit production overlap in the Upper Danube and Tisza. The EBA and MBA of Hungary are the first, unique, and appreciable numbers of horse bone and bit finds in the whole of Europe. The staggered orientation of horses at specific tell sites that are also considered to be on trade routes for metal ores is also quite intriguing.

Spatially, their presence seems to be related to trade, either of the horses themselves or of metals or both, and ore procurement (Figure 4.18).

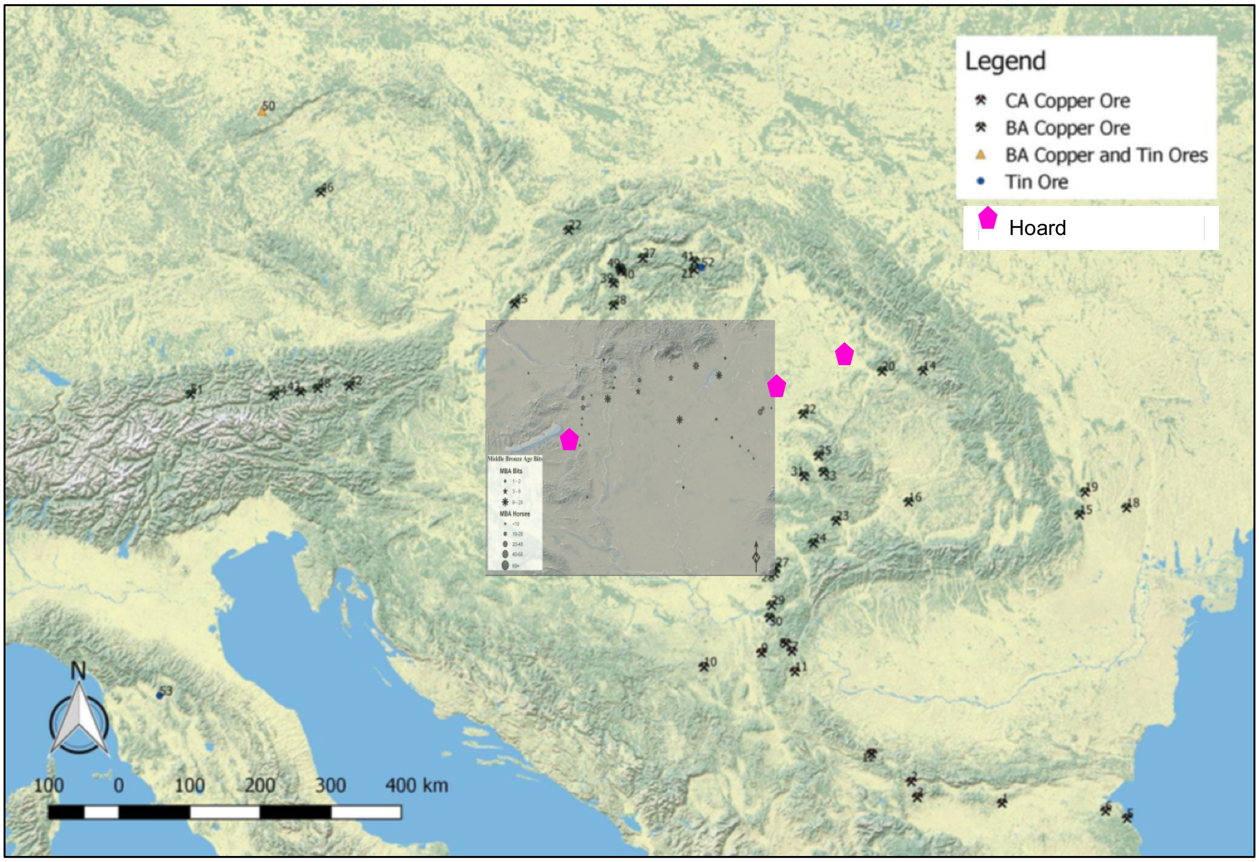

Figure 4.18. MBA Horse in HRC and Bit Distribution Inset on Map of Ore Deposits (Szigeti et al. 2017:Figure 4) and with Major Hoards Shown.

In an effort to visualize the relationship between metals and horses, I mapped the Late MBA Koszider Period, 1600-1500/1450 BC, hoard finds to horse bone finds and their relative frequencies (Kemenczei 2003a; Pernicka et al. 2016). An even more suggestive and distinctive image arises, as it does with the amber finds (Jaeger 2017) (Figure 4.19). These associations likely speak to broader issues of innovation, trade, change and continuity developed during the MBA that peak at the late MBA Koszider transition to LBA, made possible with horses.

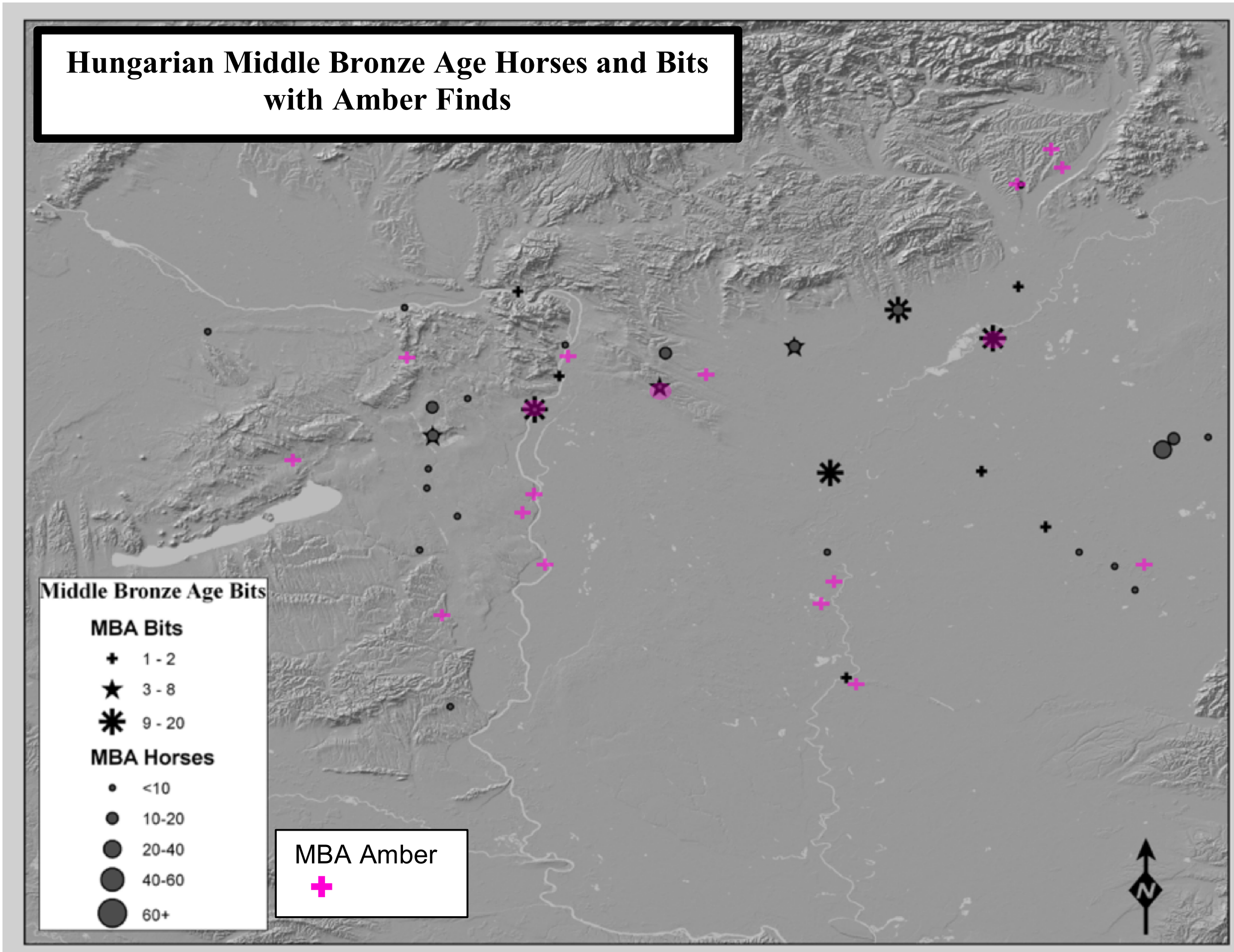

Figure 4.19. MBA Horse in HRC and Bit Distribution with Amber Finds (after Jaeger 2017:207, Figure 1) in Pink.

The Koszider Period: 1600-1500/1450 BC

The terminal MBA is called the Koszider Period named after bronze hoards found at the Vatya tell settlement of Dunaújvaros-Kosziderpadlás (Bóna 1975; Bóna 1992; Mozsolics 1967). There were also two complete horse skulls, quite unusual for the MBA, recovered from contemporaneous layers at the settlement of Dunaújváros-Kosziderpadlás (Bökönyi 1978). Formerly, this period was interpreted to be one of turbulent upheaval brought by invading mobile

pastoralist warriors from Southern Germany called the Tumulus Culture that ended the tell cultures of the Danube and Tisza. While the some tell culture traditions did decline in terms of population density and settlement size, this period has been demonstrated as a longer, non-violent transitional horizon, with new radiocarbon dates stretching back its genesis as far as 1800 BC, and many peoples remaining in place or moving to new areas within regions (Fischl and Reményi 2013; Fischl et al. 2013; Poroszlai 2003b). The Koszider Period also demonstrates evidence of long distance connections to Scandinavia and the Aegean, although the nature, strength, and extent of these relationships are debatable. These connections are drawn primarily on similarities of the distinctive spiral motifs, termed *Karpatenländische-ostmediterrane Wellbandornamentik* (the Carpathian-East Mediterranean Wave Band Motif) (David 2007) first found on the antler cheekpieces of the Hungarian MBA, and also found on hoarded and interred bronze weapons from Hungary and copied in Scandinavia (Kristiansen and Larsson 2005; Maran and Moortel 2014; Vandkilde 2014), a topic I tackle in detail in Chapter 6. Curiously, these bits and weapons have never been found together.

Rather than a simultaneous decline of population, some tells were already depopulated before the Koszider Period, others remained occupied even through the LBA, and a few new tells a villages were founded. Regional settlement surveys highlight the general tendency of a reduction in settlement size and population during the Koszider Period. With the Gyulavarsánd and Füzesabony, the overall number of settlements decreased and with the Transdanubian Encrusted Pottery Ware Culture fortified hilltop settlements went from nine to six (Fischl et al. 2013). There were also the foundation of new settlements at this time however, and a general restructuring of the population may counter the idea of settlement nucleation found in the Benta Valley, especially

a depopulation in the southeast and a settlement of piedmounts (Duffy 2010; 2015; Fischl and Reményi 2013).

In the Koszider Period, previously distinct pottery becomes more uniform, less varied in form, in some cases less refined, while decorative styles were exaggerated and elaborated (Polanyi 2010; Sofaer 2006; Vicze 2011). This perhaps speaks to increased interactions between regional areas (Fischl et al. 2013). The most obvious material signature of the Koszider Period was the appearance of new jewelry, weapon, and tool types. Burial rites, previously rather uniform, become more varied, elaborated, and exaggerated. Polanyi (2010) finds the cremation burials of late MBA Vatya transition in the Kosizder period to be one of a rather radical reordering indicating a rise of individuality, rather than formerly expressing solidarity of community in the group cemeteries of the earlier MBA. The cremation urns become flamboyantly decorated and diverse. Bronze disappeared from the urns while it increased in the aforementioned hoards of the Tolnanémdi group (west of Danube, mostly jewelry) and the Hajdúsámsori group (east of Danube in Tisza region, mostly weapons and more gold) mostly dating between 1600 – 1400 BC, but perhaps some as old as 1800 BC (Fischl and Reményi 2013). The hoard composition changes during the Kosizer Period, with an increase in tools, such as axes and sickles, a wider variety of finished objects, amber and amber beads, and much more bronze scrap (Polanyi 2010). The overall number of hoards increases and the bronze objects were manufactured from a probably uniform ore source and different composition (Pare 2000; Pernicka et al. 2016). This may mirror a larger supra-regional unity suggested by the ceramics, divided between the east and the west of Hungary.

Fischl et al. (2013:363) suggest the geographical and typological split in hoard types may imply a decrease in the role of the warrior elite in the east with an increase in the importance of the warrior in the west.

> The weapons are usually richly decorated with engraved spiral and geometric motifs, which we may interpret as the increased material and symbolic elaboration of a warrior elite identity. Some of the weapon hoards only contain one or two items, which may represent the weapon set of a leading warrior, while others contain numerous weapons. These may be connected to rituals involving groups of warriors, for example the creation of alliances or the deposition of weapons after victorious battles.

However, as in the earlier MBA, evidence for warfare in the Koszider Period is quite limited, despite all the showy weapons (Szeverényi and Kiss 2018). Far from being a deposition of dead warriors and horses like that which occurs in the LBA at Tollense c. 1250 BC (Jantzen et al. 2011; Price et al. 2017), a mass grave at Érd 9/4 in the Benta Valley is mostly the result of ritual violence over an extended period of time (Pap et al. 2008; Szeverényi and Kiss 2018).

While swords of the Hajdúsámson/Apa type have been found in Scandinavia, these are locally made copies of the Hungarian types and are found in graves rather than hoards (Vandkilde 2014:604). Those studying the Nordic Bronze Age and the narrative of an international system of Bronze Age warrior elites generally conflate the dates of the Hajdúsámson/Apa swords, the emergence of chariotry on the Pontic Caspian steppes, the MBA bit finds, finds of bits from Mycenaean and Greek contexts; over-interpret similarly decorated bone pieces as whip ferrules (handles) for chariot drivers; and misinterpret the careful reconstructions of Hüttel's (1981) bit circles to overextend equestrian interactions. Vankilde (2014:602–603) recounts this narrative:

> Kristiansen and Larsson (2005:128–186) described the period 1800-1400 BC as formative for both the Nordic and the European Bronze Age. In their view, it was during this broader era that chiefly lineages emerged, sustained by wide-ranging elite networks and a new sun-cosmology in addition to prestige technologies of metalworking and particularly horse-

> chariot gear: '…it represents the formation of the so-called steppe corridor linking the Altai with the Carpathians, and ultimately China with Europe'.

Bits similarly decorated with spiral and wave motifs to the Hungarian finds, the *karpatenländischostmediterrane Wellenbandornamentik*, the Carpathian-East Mediterranean wave band decoration (David 2007), have been recovered in Mycenaean shaft graves dating to the Late Heraldic I and II (LHI, LHII) in Greece and Karum 1B in Anatolia (1650-1500 BC) (David 2007; Maran and Moortel 2014). Kiss and Fischl (2015) connect the Füzesabony culture to Nordic EBA cultures (Nordic EBA: 1700-1100 BC, NBA Period 1: 1700-1500 BC, Nordic NBA 1B 1600-1500 BC) along the Hernád River, which runs into the Oder and Elbe Rivers to Northern Europe. They consider the Füzesabony to be the primary cultural context for the development of the Apa-Hajdúsámson metallurgical tradition based on finds, and its distribution of object types shows connections between Apa type swords that concentrated on the Upper Tisza Region and the eastern Jutland Peninsula. Vandkilde (2014:617, Figure 7) also illustrates a pair of antler cheekpieces from Nordic EBA IB Østrup Bymark, Denmark was incised with similar motifs. However, Fischl et al. (2013) caution that significance and real extent of the connections is still under debate. Jaeger (2017) analyzed and mapped the amber finds of the MBA, which date back as far as 2000-1850/1800 BC, just at the turn from the EBA to the MBA, and offers similar caution about the presence of amber on Hungarian settlements, burials, and hoards, to the so-called amber routes linking Scandinavian with the Aegean through Hungary. There are 35 finds of amber from the MBA of Hungary, with locally made copies of resin at Százhalombatta-Földvar.

Intriguingly, because of the fine excavation techniques at Százhalombatta-Földvár, the Koszider Period can be examined through the faunal assemblage (Vicze 2005). In this terminal MBA period, all animal species decline, except dogs and horses increase in number slightly but

appreciably from the previous MBA level (Choyke et al. 2004). This may imply an increased need for horses and dogs for uses other than herding, and that were more in the line of protection. The proliferation of weapons and changes in settlement structure perhaps join here in documenting evidence of a warrior class.

The end of the MBA Koszider Period and beginning of the LBA may more accurately mark the emergence of a warrior elite, based on chronology, material evidence, faunal evidence, and environmental clues. Despite that Kristiansen and Larsson (2005) label the tell building cultures of the MBA Carpathian Basin as warrior aristocracies, all of the aforementioned evidence points to a mosaic of more corporately oriented polities, whose exclusionary metals based political economies did not occur until the LBA, *after* the decline of the MBA tell building cultures. The hoards, which are so often pointed to as evidence of the importance of the metal trade to the MBA political economies, do not date until the Koszider Period. Despite some challenges in dating the antler cheekpieces of horse bits, which will only be resolved with radiocarbon dates of these precious artifacts, the horse bits, and their spiral motifs like those on the hoarded weapons, actually were made *earlier* and throughout the EBA, MBA and LBA (Chapter 6). Horse husbandry and the equestrian traditions of the Carpathian Basin likely occurred first in the EBA to MBA, as did the antler bit manufacture with the wave band motif, and out of these practices, because of equestrian innovations (in the context of environmental, social, and political changes) the warrior elite grew in the transitional Koszider Period to restructuring at the beginnng of the LBA.

The Late Bronze Age: 1400/1300 BC – 900/800 BC

The aforementioned Tumulus Culture are now thought to be people who were able to migrate into Hungary from the west because of the slow decline of the tell building cultures and

general decentralization and depopulation of formerly occupied areas, in the context of some ecological stress. There is good evidence of a long coexistence of local populations and Tumulus peoples, with radiocarbon dates to substantiate this, occupying distinct territories and settlements simultaneously (Fischl et al. 2013; Gogâltan 2008, 2018; Przybyła 2016). Primarily known from their tulmuli burials in large cemeteries, the Tumulus Culture spans from western into central Europe, but apparently local MBA peoples were central to its allowed introduction and formation (Csányi 2003b).

The coexistence of the local and Tumulus peoples is demonstrated from the 278 Tumulus Culture graves excavated at Jánoshida and those from contemporary cemeteries in Hungary, where there was a strong local Hungarian tradition of burial rites that differed from the Tumulus of southern Germany, Austria, and Bohemia. Cremation, scattered and inurned, and inhumation graves were recovered at Jánoshida, with bronze or gold jewelry and weapons and food vessels. Despite being systematically looted later in time, Csányi (2003b) suggests about half of the people were buried with gold articles. The ratio of inhumation to cremation seems to follow local preferences of these burial rites from previous periods, and the Tumulus burial grounds skew to existing preferences for each rite. Despite being named and known from the practice of burying the dead under circular stone grave mounds, very few of these tumuli have been found in LBA Hungary. Four of the burials at Jánoshida were enclosed by a circular ditch and covered by an earthen mound. Individuals from Jánoshida are included in my study for skeletal markers of horseback riding (Chapter 8).

At the Vatya cemetery of Dunaújváros-Duna dűlő, 33 Tumulus burials document a strong relationship and continuation with Late Vatya peoples via successors of Vatya-Koszider pottery

(Vicze 2011). Sánta (2011:6) sees the Tumulus as growing out of the Koszier Period and as the inner cultural cohesion of society weakened and peoples' connections turned more abroad, resulting in an integration of local groups with extra-regional arrivals. Unbroken occupation and internal transformation is further seen in settlements and cemeteries of Transdanubia and the Great Hungarian Plain (Szabó 2003).

There was some climatic deterioration at the beginning of the LBA with its correspondence to the late Sub-Boreal period became wetter and cooler (Sümegi and Bodor 2005). Rising water levels would have reduced previously available pastures. However, obvious climatic change was not observed in the Benta Valley in the immediate transition to the LBA, where environmental degradation apparently did not occur until towards the end of the LBA, between 1200 and 1100 BC (French 2010:47–48). Populations in the Benta Valley may have felt the above climatic and environmental factors earlier due to their over millennia long occupation of the valley and obviously successful agricultural practices that permitted such a long, continual residency. Their sensitivity to environmental changes probably precipitated the abandonment of the tell settlements and movement of populations into more dispersed settlements in order to retain viable pasture and arable land. Fischl et al. (2013:360) find that during the Tumulus Culture Period,

> the new settlement patterns without signs of long-term occupation seem to reflect a different social and economic organization, a different perspective on the landscape and probably a different legitimization of power. Obvious major centers like tells and hilltop sites disappear, and give way to an open network of open settlements. Some differences between their sizes do exist that may indicate social differences as well. Generally, we are faced with a more decentralized network of polities, possibly without high-ranking chiefs achieving large-scale political integration.

Settlement in all regions apparently followed this trend. In the Benta, there is only one Tumuls site (Vicze et al. 2005). In southeast Hungary in Békés County, sites decrease by more

than half as they do on the southern Great Hungarian Plain, west Hungary (Veszprém County), and in the Little Balaton (Transdanubia) (Kiss and Kulcsár 2007). The Tumulus peoples also began to occupy previously uninhabited regions. House sizes were more variable and communal buildings may have been constructed (Fischl et al. 2013). While previously reported as a period of substantial changes in subsistence and lifestyle (cf. Kristiansen 2000:376–384, 412:Fig. 224), zooarchaeological and archaeobotanical studies do not document substantial differences in animal and crop production from the MBA. The Tumulus do not appear to be any more mobile than earlier peoples, but may have practiced a more extensive form of animal husbandry and herding, with some evidence of a renewed dominance of cattle (Sánta 2011:256; Vretemark 2010:172).

Interpersonal violence appeared with the transition from the Tumulus to the Urnfield periods, c. 1400 BC, at the site of Velim-Skalka in the Czech Republic (Harding et al. 2007). At this site, human remains (MNI:24) from infants, juveniles, sub, adults, and adults, both female and male, document widespread blunt and sharp force trauma, probably from battle-axes and stone arrowheads, from multiple attacks. Violence may be clearly seen on the bones, but this site has also been interpreted as a ritual complex because the pits and ditches were reopened several times, bones re-cut, and people were intermingled with animal remains. This site also has a high abundance of horses, 8.3% NISP of the domesticated fauna, HRC 14.6 (Knüsel et al. 2007).

After the Tumulus, occupying territories of the former tell cultures east of the Tisza was the Gáva Culture, a South-East European cultural complex, while the western Danube-Tisza interfluve and Transdanubia were settled by the western European extension of the Urnfield Culture, and in the Kyjatice in the Northern Mountain Range (Szabó 2003). More similar material culture belies an expanded and highly connective interregional network. Bronze tools and weapons

were more uniform and widely available to the general population, and a new class of defensive armor appears (Jankovitz 2016). There was a large boon in metallurgical output and the appearance of major production centers. The overarching symbol of increasing homogeneity, the Urnfield, indicates cremation became the overwhelmingly dominant form of burial rite. Houses were generally uniform throughout Hungary, in size, shape, and construction, and in the presence of a great number of pits, and similar to the timber framed Koszider Period houses (Artursson 2010). Some longhouses were found as well, dating to the early Urnfield Period.

There was a consistent and strong growth in the number of settlements ranging from hamlets to villages and substantial hillforts throughout the Carpathian Basin in the Urnfield Period (Kemenczei 1994; Szabó 2003). In the Benta Valley, 85% of the settlements that were occupied in the MBA were occupied again in the Urnfield Period, sizes of the settlements grew, but population density decreased (Artursson 2010:112). Most of the population still lived in unfortified open settlements (Figure 4.20). New and substantial fortifications with ramparts, ditches, and fences were now common at ‘true hillforts’, built at strategic high points all over the Carpathian Basin, many occupying the earlier MBA village settlements.

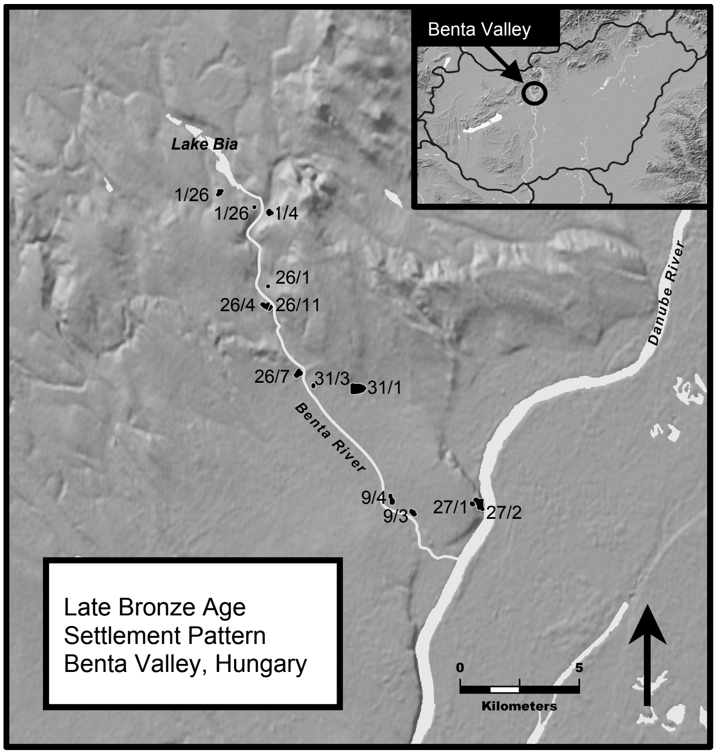

Figure 4.20. LBA Settlements Pattern in the Benta Valley.

The first evidence of Bronze Age group warfare comes from site of Tollense from the marshes of Northeastern Germany, c. 1250 BC, at roughly the transition to the Urnfield period (Brinker et al. 2016; Jantzen et al. 2011; Lidke et al. 2015; Price et al. 2017). Despite assumptions of violence inherent in the interpretation of Bronze Age societies as warrior aristocracies (Fylingen 2006; Kristiansen and Larsson 2005; Vandkilde 2011), this is the only known evidence of a Bronze Age battlefield; there is little indication of much traumatic injury from this period beyond some incidences of interpersonal or ritual violence (Peter-Röcher 2006, 2007; Szeverényi and Kiss 2018; Ubelaker and Pap 1996). Remains of 130 men, 5 horses (ratio of 1:26 men to horses), bronze and wooden weapons, flint arrowheads (some in bone), and jewelry were recovered, while only 10% of the site was excavated (Jantzen et al. 2011). Men literally died on horseback, and many

apparently have skeletal lesions (described as 'riding facets') the authors identify as related to riding (Price et al. 2017). No evidence of chariotry whatsoever was found at Tollense. There were local and non-local warriors present, the isotope evidence indicates the non-local groups may have come from as far as the Czech Republic, the horses have strontium isotope values that suggest they were imported, and have $^{87/86}Sr$ ratios known from Hungary and the Czech Republic (Giblin et al. 2013; Price et al. 2017; Chapter 5).

Crop agriculture gained a more important role in the LBA, and it had consequences. Towards the end of the LBA, the degradation of the Benta Valley landscape came to a critical juncture after nearly 1500 years of occupation (French 2010:55):

> This equilibrium was sharply broken in the later Bronze Age, about 1200 to 1100 BC, with river avulsion and the downslope erosion of loessic silt deposits. This latter feature has an inescapable linkage with the intensification of arable [crop] land use, but it was short lived. This landscape quickly re-stabilized after a century or so, despite the increasing importance of arable crops over grassland in later prehistoric and historic times…there was a major period of soil erosion leading to the aggradation of eroded soil in the upper one-third of the palaeo-channel fill sequences. It is hard to avoid the conclusion that the uptake of former grassland for arable land use in the later Bronze Age was responsible for this, as well as severe exploitation or disruption of the woodland on the margins of the floodplain.

With pastures giving way to crops, the LBA was a continuation of MBA animal husbandry practices, with added dispersal of animal grazing to higher pastures. The faunal distributions indicate similar relative frequencies of domesticates to the MBA (Figure 4.21 & 4.24). However, there is a slight increase in horses from the MBA to the LBA from Jászdósza-Kápolnahalom when the relative frequency of horses is expressed as HRC (Figure 4.22 & 4.23). Horse breeding and equestrianism continued to play a key role in LBA societies, and perhaps a larger role in raiding and warfare by this period if Tollense is any guide. Choyke and Bartosiewicz (2009) document the importance of horses at Jászdósza-Kápolnahalom on the Great Hungarian Plain. From the Late

Urnfield Period (1050-800 BC), horse skulls were placed in graves in Eastern Hungary, and this practice continues into the EIA (Kmeťová and Stegmann-Rajtár 2014:149).

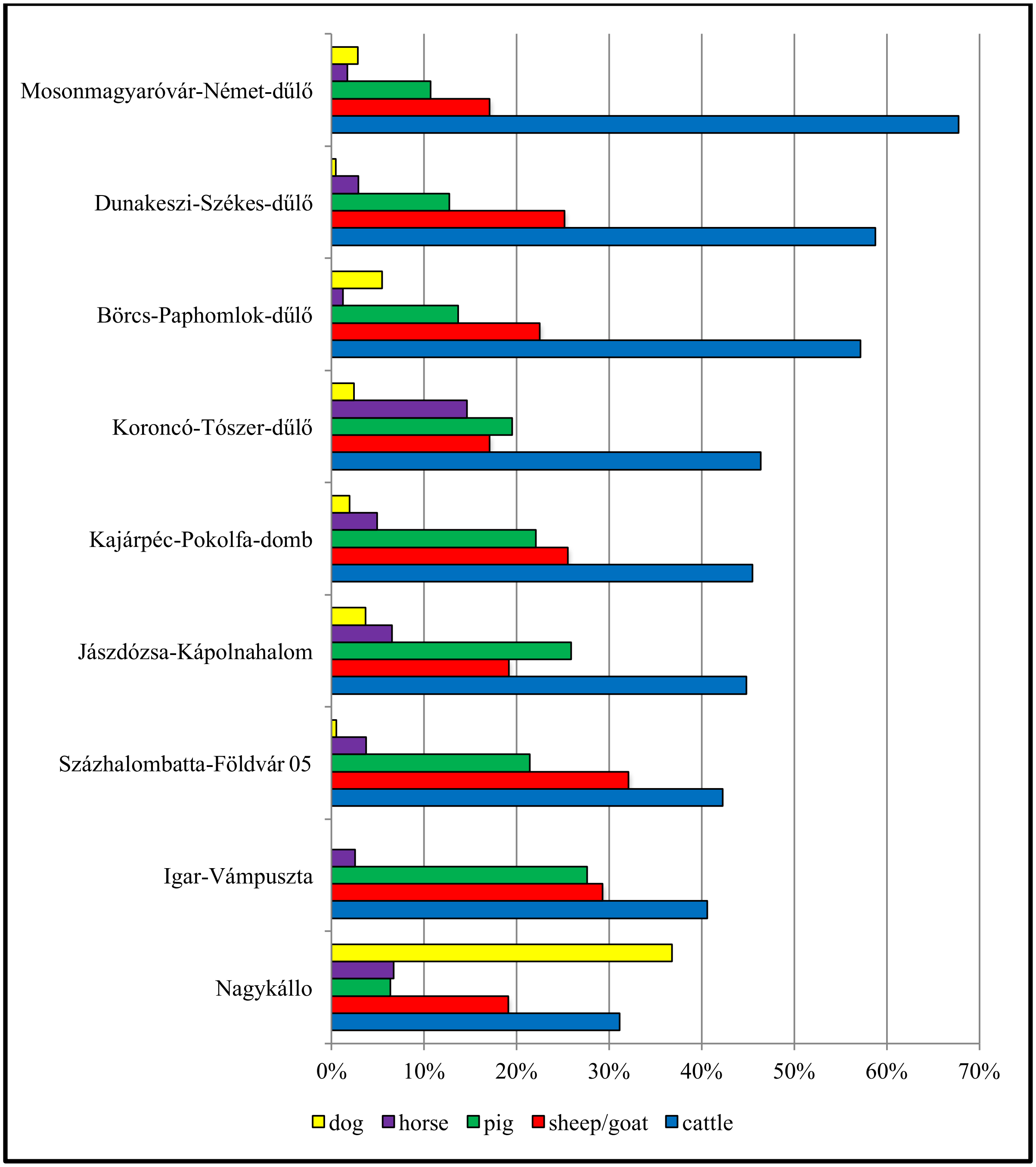

Figure 4.21. LBA Relative Frequencies of Domesticated Fauna in NISP %.

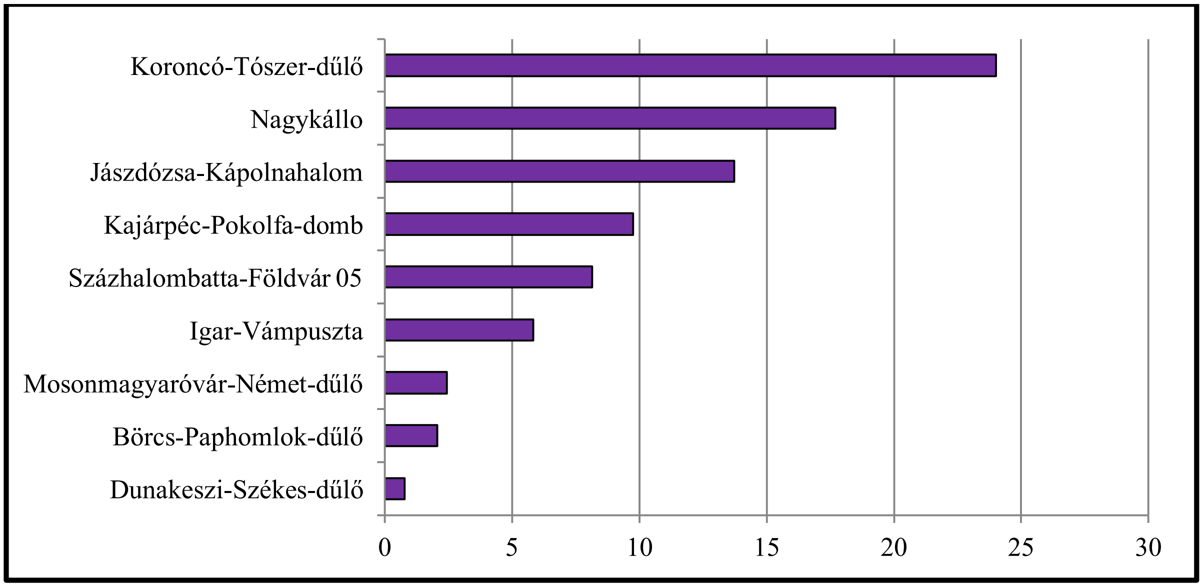

Figure 4.22. LBA Horses in HRC.

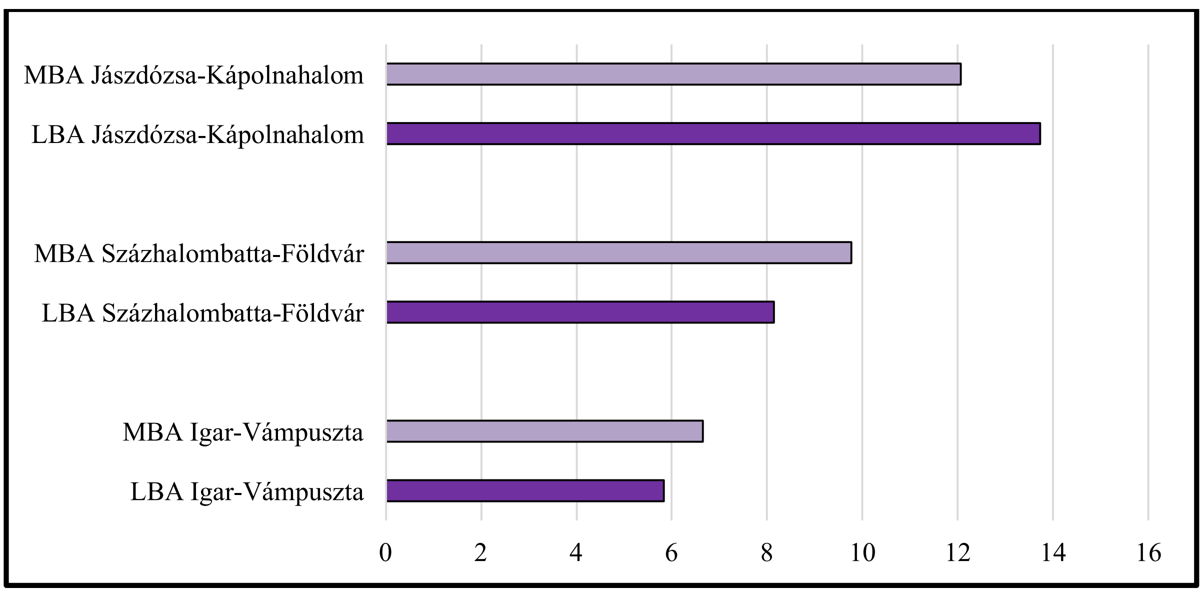

Figure 4.23. Comparative MBA to LBA Horse Relative Frequency as HRC.

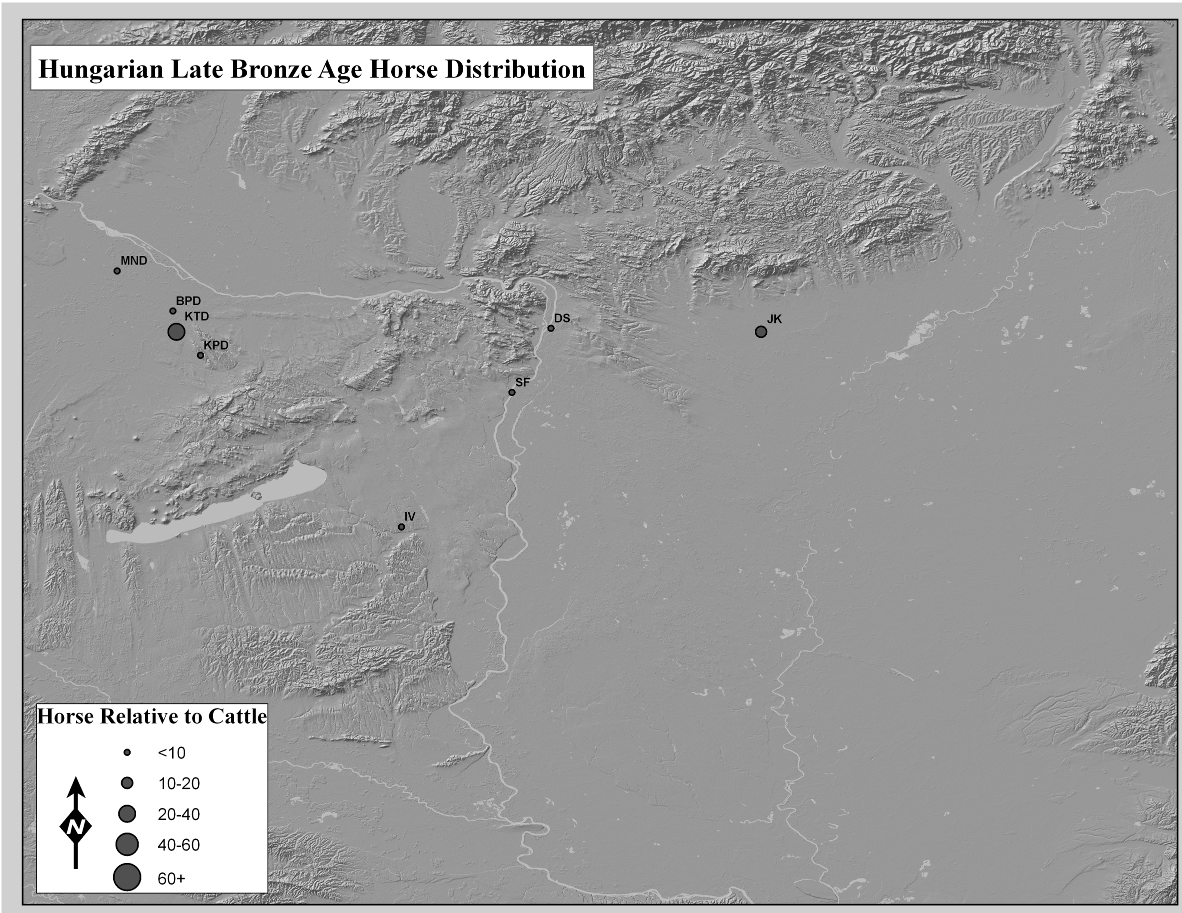

Figure 4.24. Map of LBA Horses in HRC.

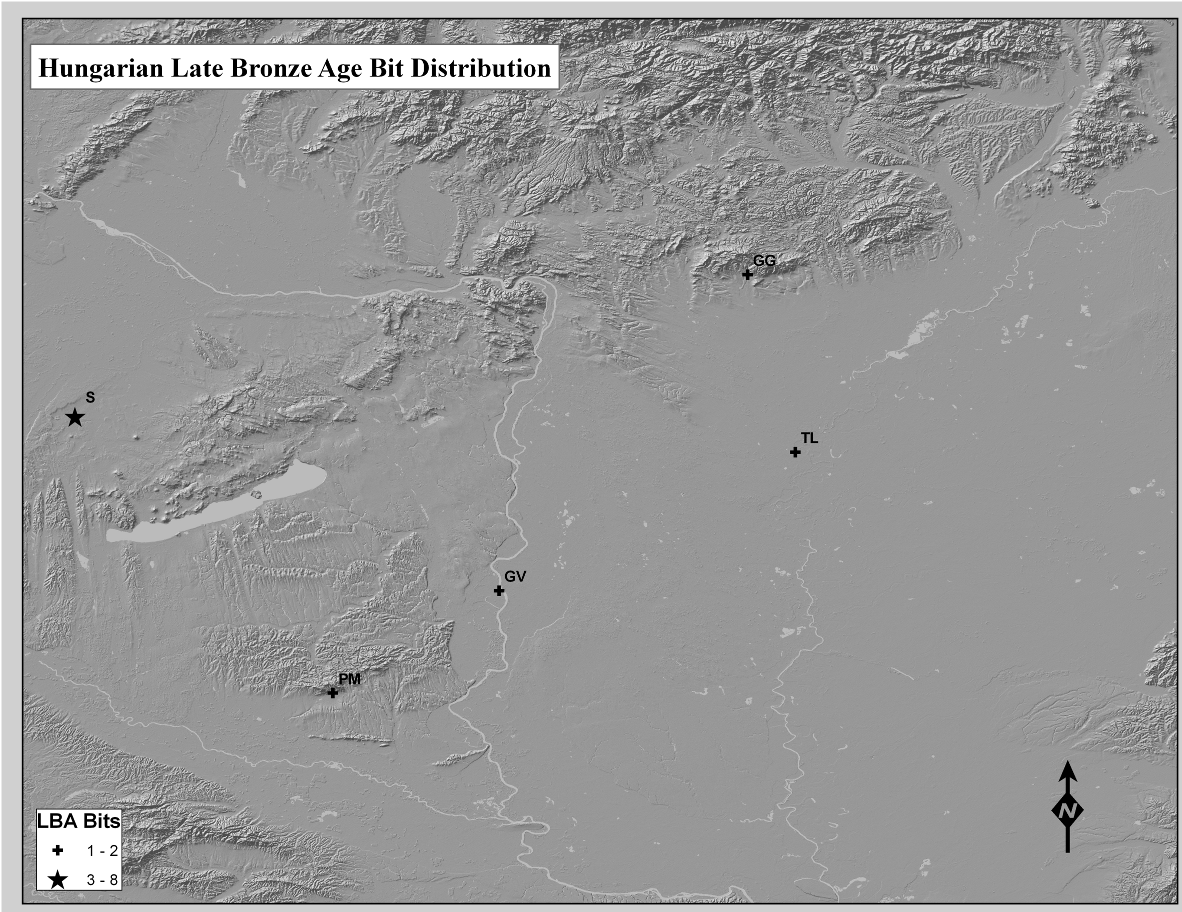

Figure 4.25. Map of LBA Bit Finds.

Idiosyncratic Hungarian bits continue to have a presence in the LBA and were replaced by bronze bits turning into the EIA (Hüttel 1981) (Figure 4.25). There was a spectacular find of a bit with a bronze mouthpiece and boar's tusk cheekpieces from a large, impressive, and still visible Iron Age barrow at Százhalombatta-Földvar. The boar's tusk cheekpieces mimic in shape and function the earlier antler cheekpices, suggesting this bit blended earlier forms with new technologies. Iron Age peoples in Hungary have a range of bits, but their form generally continues the long cheekpiece type of the antler bits, an indication that riding still remained the main form of equestrianism in the face of widespread chariotry in other regions of the LBA.

The end of the LBA and the Iron Age (900/800-475 BC) brings with it a flurry of changes again to the Carpathian Basin with the arrival of the so-called Pre-Scythian, Scythian, and Halstatt Cultures, many of whom were most certainly mounted equestrians. With them come an explosion of artifacts depicting horses and buried horse remains with people, split between prestigious elite burials in the western part of Hungary, like that of the Százhalombatta-Földvár barrow, and people of all social classes interred with horses in the eastern part (Kmeťová 2013b). These are truly the burials of warrior horsemen, and maybe even their grooms and caretakers. Intensive horse breeding probably occurred at this time in Eastern Hungary (Metzner-Nebelsick 2002). As noted earlier, the relative frequencies and HRC of horses from the settlements of these documented horse breeders is in line with the amounts from EBA, MBA, and LBA settlements. Bökönyi (1968) discerns solid evidence of horse breeding in the Iron Age, with a larger (Eastern) and smaller (Western) type of horse defined by metric analysis. The Hungarian Iron Age horses fall within the larger and sturdier type, another implication of this region's long-term traditions of intensive horse breeding. While there were significant cultural changes, this continued emphasis on equestrianism and horse breeding throughout Hungarian later prehistory emphasizes the suitability of the region for this purpose.

Review of the MBA to LBA

Upon closer inspection, a review of the chronology, material culture, households, and settlement patterns of the tell building cultures of Bronze Age Hungary demonstrates more complex, heterogeneous, and perhaps collectively oreinted trajectories of polity development and decline than afforded by earlier grand narratives of warrior aristocracies and elite control. While

settlements and populations both grew in size and density in the MBA, they declined in the early LBA, and expanded again in a more decentralized fashion in the Urnfield Period. During the MBA *floruit* of the tell building cultures, neither settlement size hierarchies or fortifications were reliably present across Hungary. House sizes were rather consistently uniform, and none seemed to be obviously elite or places of more than part-time craft production. Metallurgy, and its related material culture, was rarer on settlements than expected and there was no direct evidence of elite control over metals. Social stratification was only somewhat readily apparent in burial rites, but this was obscured by large, formal group cemeteries. Crop agriculture was focused on local production and consumption and there was no evidence anywhere for its obvious surplus. Animal husbandry practices were heterogeneous intra-regionally and between regions and may have been complementary within and between groups. While orientation for secondary products of dairy and traction cattle and wool sheep was apparently widespread throughout the Hungarian Bronze Age and was observed in the Benta Valley, and maybe the Berettyó Valley, the limited evidence of specialized wool production at Százhalombatta-Földvár or meat provisioning of this tell complicates the narrative of agricultural surpluses being mobilized by elites for the bronze trade. This is unexpected, but not dissimilar to other recent studies of Bronze Age Hungary, which have found different trajectories to complexity not mediated by elites (Duffy 2010; 2015; Jaeger 2018; Jaeger et al. 2018; Quinn 2017; Quinn and Ciugudean 2018).

Horses spread throughout Hungary during the MBA to settlements of the tell building cultures. Compared to later periods of equestrian peoples, horses were actually relatively abundant at this time. Horse bits were produced uniquely and widely throughout Hungary, and are the earliest horse bits known to have been made. The horse bit motifs match those on hoarded bronze

weapons and jewelry found in the terminal MBA Kozider Period. The similar motifs imply international exchange in material culture related to horses and weapons from the Aegean to Scandinavia. Ridden horses provided a new mobility that could afford such widespread interactions and trade, but this did not necessarily require a warrior elite. When all other animals declined, there were very slight upticks in horses and dogs at the same time. This could mean an increased need for protection. However, good evidence for extra-group, mounted warfare does not make an appearance until several hundred years later at the only known Bronze Age battlefield of Tollense in southern Germany at 1250 BC. This coupled with the environmental degradation and decreased agricultural productivity known in the Benta Valley between 1200 and 1100 BC, along with the migration in of additional cultural groups in the period, may indicate that there were a number of stressors that led to a need for more organized mounted warfare, and perhaps a warrior elite, to develop at the end of the LBA and into the Iron Age. Indeed, that horses become buried with people, their bits, and weapons is a strong signal that horses began to transition into a deeper incorporation into politics and warfare at the end of the Bronze Age, rather than at the beginning of it.

CHAPTER 5

Political Provenience:
Discerning Specialized Production of Horses in the Hungarian Bronze Age

If economic specialization in the broadest sense is production that leads to exchange (Flad and Hruby 2008), then evidence for specialization in horse breeding should be obtained through identifying the patterns and scale of their production, surplus, and exchange during the Hungarian Bronze Age. If specialization in horses occurred to support an emergent political economy with elite equestrian warriors, there should also be an increase in the numbers of horses through time (intensification) with markers of selection for particular traits in horses (commoditization). In this chapter, I demonstrate that there were: 1) a sufficient number of horses present in Hungary at this time for multiple uses, 2) comprised of full breeding populations, with 3) the potential to produce a surplus for use, and for 4) trade. I found some indication of selection for height and refinement. I do show that horses were definitely large enough to ride, the largest by far in Europe at the time. However, horse breeding was not intensified through the period. Rather it seemed oriented towards use within the communities for herding, travel and trade, with continued variability expressed at settlements within different cultural regions. Additionally, the faunal analysis provides little evidence of control of horse breeding or use by any one faction or group, elite or otherwise.

To examine horse breeding and potential specialization, I analyzed published faunal assemblages that contained horse remains from 74 settlements of the Bronze Age of Hungary, which I compared with the horse bones from 37 faunal assemblages of sites from later periods. Five areas of analysis were employed: 1) *numbers:* the relative number of horses to other domesticated taxa; 2) *breeding population:* the mortality profiles of horse populations; 3) *surplus*

potential: estimates of ancient living populations of horses; 4) *trade:* stable isotopes taken from horse teeth; and 5) *commoditization:* the biometric quantification of the horse bones.

Identifying the Number of Horses in Bronze Age Hungary

A review of the relative frequencies of horses, expressed as NISP % of the domesticated taxa in the faunal assemblage, leading up to and through the Bronze Age proved demonstrably that domesticated horses were present in Hungary at this time. Chapters 3 and 4 illustrated the introduction of horses into Hungary beginning in the Copper Age through the Bronze Age. There was a remarkable and significant increase in the number of horses appearing in the EBA at Bell Beaker sites on the Danube bend at Budapest, at a group of sites called the Bell Beaker-Csepel Group: Albertfalva, Budakaláz, Budapest-Békásmegyer, Csepel-Háros, Csepel Hollandi Út, and Szigetszentmiklós. The extremely high numbers of horses at these sites suggests that the animal husbandry practices of these EBA peoples were focused on breeding horses, with the other domesticates playing a supporting role (Table 5.1).

> A special feature of the Albertfalva settlement and common theme of the various households was animal breeding and trade, namely that of horses. This knowledge is based on their structure as out extrapolations were based on the structure of houses: arched sidewalls, two-roomed with a minor and major space, and the latter must have been used to stable horses which played a key role in commerce. The equal size of the houses assumes a more or less equal number of livestock through family. Successful equine husbandry and the trade of exceptional specimens were ultimately the driving force behind the political power and husbandry of the Bell Beaker-Csepel Group. (Endrődi and Reményi 2016a:101–102).

By the numbers, the Bell Beaker-Csepel Group peoples demonstrate the earliest tradition of specialized horse production at sites along the Danube Bend in the EBA. Horses were present in unprecedented numbers at these settlements, in relative frequencies of domesticated taxa that

are unmatched at any contemporaneous sites in Central Europe at this time, ranging from roughly 42% to over 60%. Moreover, these frequencies were unmatched at any other time in the history of the Carpathian Basin and likely in all of Europe. This specialization in horses probably follows developments in horse husbandry that first occurred on the Pontic Caspian Steppes and represents the continued extension of those practices and peoples into Central Europe. Recent human genetic data supports this idea (Goldberg et al. 2017).

Site	Culture	NISP % Horse	Source
Csepel Hollandi Út.	Bell Beaker	59.31 %	Bökönyi (1978)
Csepel-Háros	Bell Beaker	44.89 %	Bökönyi (1978)
Szigetszentmiklós-Üdülősor	Bell Beaker	50.00 %	Endrődi and Remémyi (2016a)
Albertfalva	Bell Beaker	41.83 %	Lyublyanovics (2016)
Tószeg-Laposhalom	Nagyrév	22.51 %	Bökönyi (1978)
Mezőkomárom-Alsóhegy	Nagyrév	15.68 % 10.86 %	Bökönyi (1978) Choyke (1984)
Dunaújváros-Koziderpadlás	Nagyrév	11.42 %	Bökönyi (1959)
Fertőboz-Gradinahegy	Máko	10.81 %	Bökönyi (1974)
Dunakeszi-Székes-dűlő	Bell Beaker	9.81 %	Csippán (2007)
Kengyel	Nyírség	9.09 %	Bökönyi (1974)
Jászdózsa-Kápolnahalom	Nagyrév	8.60 %	Choyke (1984)
Polgár-Bastanya	Nagyrév	8.55 %	Bökönyi (1959)
Békásmegyer-Buváti	Zók/Nagyrév	8.25 %	Bökönyi (1974)
Győrszemere-Tóth-tag	Somogyvár-Vinkovci	5.13 %	Choyke and Bartosiewicz (1999)

Table 5.1. NISP % of Horses Above 5% at EBA Settlements.

A selection of contemporaneous EBA settlements also had horses in appreciable numbers (Table 5.1). These sites likely represent the early dispersion of horses into cultures surrounding the Bell Beaker-Csepel Group in the EBA. This data could simultaneously indicate that both horses and people were integrated into these cultural groups.

> Horses had a vital role in the everyday life of the settlements typical of the Bell Beaker-Csepel Group, in the case of which intense horse breeding can be identified prevalently. The quantity of horses in the settlements typical of the Bell Beaker-Csepel Group is remarkably significant (Bökönyi 1978; Piggott 1983:89; Kalicz-Schreiber and Kalicz 2001), so that we can postulate the distribution territory of the group was the influential center of breeding/domestication and trade. The latter center may have served as the starting point of wide-range distribution of horses in Europe through the network of settlements typical of Bell Beaker Culture which developed along major European rivers in the middle of the 3rd millennium BC (Endrődi and Reményi 2016a:232).

The EBA Bell Beaker-Csepel Group horse economies kicked off a novel and widespread diffusion of horses into the MBA. The unusually high reliance on horses apparently becomes altered into the transition to the MBA, as horses were considered differently into this period (Chapter 6). At the beginning of the MBA, the overall numbers of horses were considerably less at tell settlements throughout Hungary than at EBA Bell Beaker sites, but they were more widely distributed. Horse husbandry became a regular part of the stockbreeding economies of the MBA.

Relative Frequencies of Horses Compared Through Time

Despite often being dismissed as low numbers unworthy of much consideration, horses expressed as the NSIP % and HRC discussed in Chapter 4 shows that MBA horse numbers were on par with frequencies of horses from later periods and peoples known to be equestrian nomads, such as the Hallstatt Cultures and the Scythians (Table 5.2). There are many reasons why horses may be underrepresented in the faunal assemblage, such as differential deposition as they were consumed less, but the most likely scenario is that breeding of horses for use and some exchange may not actually require high frequencies of individual animals. Moreover, because 'using' horses survive commonly into old age in the Hungarian Bronze Age, they outlive many generations of the other livestock, resulting in a lower relative abundance compared to other domesticated taxa.

MBA Sites	Culture	NISP % Horse	Source
Füzesabony-Öregdomb	MBA Füzesabony	6.55 %	Bökönyi (1959)
Jászdózsa-Kápolnahalom	MBA Füzesabony	7.00 %	Choyke (1984)
Lovasberény-Mihályvár	MBA Vatya	7.81 %	Choyke (1984)
Bakonszeg-Kádardomb	MBA Gyulavársand	10.94 %	Bökönyi (1988a)
LBA Sites			
Jászdózsa-Kápolnahalom	LBA Tumulus	6.51 %	Choyke (1984)
Nagykállo	LBA Gáva	6.69 %	Bökönyi (1974)

Table 5.2. NISP % of Horses Above 5% from MBA and LBA Settlements.

Certain MBA Hungarian settlements that have a larger NISP % of horses may potentially represent those places where horse breeding was of particular consequence. When combined with the horse bit data (Chapter 6), this picture can be further clarified. The dispersion and numbers of horses indicate horse breeding may have been specialized and oriented towards exchange at particular MBA polities, but that does not exclude settlements with lower numbers of relative horses from doing the same on a smaller scale. In the LBA, horse breeding continues on a similar small scale, but there are far fewer settlements represented.

A notable standout in the number of horses in the MBA occurred at Pecica-*Şanţul Mare* in Romania (Nicodemus 2014). This major tell settlement is considered to be a part of the Maros/Perjámos cultures, but is rather unique in its concentration of horses and metallurgy (O'Shea and Nicodemus 2017). Horses were present there in small numbers in the EBA, but increased considerably in the MBA, a pattern unlike and unmatched at the other tells of Hungary (Table 5.3). This fortified settlement, along with its unusual ritual deposits of mares in the rampart, indicates that this site was an important center of specialized horse husbandry in the MBA.

Period	Date	NISP % Horse
EBA	Pre-1900 BC	2.40 %
MBA 1: Florescence	1900-1720 BC	19.7 %
MBA 1, Phase 4: Florescence	1820-1770 BC	30.0 %
LBA	1720-1500 BC	5.40 %
BA Average		*11.9 %*
Iron Age	300-100 BC	1.90 %

Table 5.3. Bronze Age Horses at the Romanian Tell of Pecica-*Şanțul Mare* (Nicodemus 2014).

When comparing the NISP % of horses in the domesticated animal taxa at MBA Hungarian settlements to Iron Age, Celtic, and Roman Period settlements, the numbers can be interpreted in a larger context of horse breeding and use in the same region through time (Tables 5.4 and 5.5). The Iron Age peoples who were known to use and breed horses extensively and should provide an indication of what the relative frequencies of horses in the domesticated taxa should look like for people who use, breed, and exchange horses. Iron Age Hallstatt and Scythian peoples were regularly buried with horses in impressive graves and had a tradition of intensive horse breeding likely oriented to international trade (Kemenczei 2003; Kmeťová 2013, 2017; Metzner-Nebelsick 2002, 2017). These groups had corresponding elaborate material culture related to horses, e.g. bits or other tack, and horses were the most common animals visually represented. The relative frequencies of horses from Bronze Age settlements in Hungary are remarkably similar to the relative frequencies of horses from settlements of these later cultural groups, with the MBA Hungarian NISP % horse ranging from 1.1 % to 10.94 %, single high outlier Pecica-*Şanțul Mare*, and the Iron Age sites ranging from 1.22 % to 12.24 %, single high outlier Jászfelsőszentgyörgy-Túróczi-tanya. The Hungarian Bronze Age and Iron Age patterns of horse presence are striking in their likeness.

Site	Period	NISP % Horse	Source
Ludányhalászi-Sóderbánya	IA: Prescythian	1.22 %	Bartosiewicz and Gál (2010)
Felsőtarkány-Várhegy	IA: Hallstatt	1.32 %	Bökönyi (1974)
Szakály-Réti Földek	La Tène	1.43 %	Vörös (1982)
Balassagyarmat-Káposztások	IA: Scythian	2.32 %	Bartosiewicz and Gál (2010)
Salgótarján-Ipari Park	IA: Scythian	3.19 %	Bartosiewicz and Gál (2010)
Garadna	La Tène	3.57 %	Bökönyi (1974)
Sajópetri-46	Celtic/La Tène	5.62 %	Bartosiewicz and Gál (2010)
Helemba-Sziget	IA: Hallstatt	6.49 %	Bökönyi (1974)
Velemszentvid	IA	12.24 %	Bökönyi (1974)
Jászfelsőszentgyörgy-Túróczi-tanya	IA: Scythian	21.7 %	Bartosiewicz and Gál (2010)

Table 5.4. NISP % of Horses from Iron Age Sites in Hungary.

The numbers of horses from Roman settlements in Hungary and elsewhere in Europe can give another dimension of comparison (Table 5.5). Written records document the reliance of these later cultures on horses and give evidence of how breeding for the military and the market was conducted (Van Dijk and Groot 2013; Groot 2008; Groot et al. 2009; Johnstone 2004). Certainly with the advent of the Roman Empire, we know that horses were required for military and civilian use in riding and draught on a wide scale, so their presence at these settlements can give a baseline for the NISP % of horses to for an empire to mount a military force in Hungary and to have animals for general civilian use. The supply of horses was not centralized in the provinces in the Roman era, such as Pannonia east of the Danube, and units obtained their horses from local sources along with the smaller number of horses they brought with them (Johnstone 2004).

Roman Province	Site	Site Type	NISP % Horse	Source
Britannia		Towns/Centers	Rarely > 5 %	Maltby (2016)
Britannia		Rural Settlements	Can be > 10 %	Maltby (2016)
Italia		Towns/Centers	< 7 %	Mackinnon (1999)
Italia		Rural Settlements	13-22%	Mackinnon (1999)
Germania – Netherlands		Military Forts	< 4 %	Groot (2008)
Germania – Netherlands		Veteran Farmsteads	6-31 %	Groot (2008)
Pannonia – Hungary	Szakály-Réti Földek	Roman Settlement	5.74 %	Vörös (1982)
Pannonia – Hungary	Visegrád-Várkert Dülő	Roman Settlement	4.24 %	Bökönyi (1974)
Pannonia – Hungary	Aquincum	Roman Town	~ 5 %	Choyke (2003)
Pannonia – Hungary	Tác-Fövenypuszta	Roman Villa	7.52 %	Bökönyi (1974)
Pannonia – Hungary	Albertfalva Vicas	Roman Fort	8.20 %	Choyke (2003)
Pannonia – Hungary	Visegrád-Kőbánya	Roman Watchtower	8.15 %	Bökönyi (1974)
Pannonia – Hungary	Tokod-Erzsébetakna	Roman Fort	11.82 %	Bökönyi (1974)
Pannonia – Hungary	Pilismarót-I Őrtorony	Roman Watchtower	12.29 %	Bökönyi (1974)
Pannonia – Hungary	Nagytétény	Roman Camp	16.40 %	Bökönyi (1974)
Pannonia – Hungary	Budapest-Albertfalva	Roman Fort	17.10 %	Bökönyi (1974)
Pannonia – Hungary	Balatonaliga	Roman Settlement	18.28 %	Bökönyi (1974)

Table 5.5. Roman Site Horse in NISP %.

The Roman Army of Germania Inferior needed over 1000 horses every year (Groot 2008). In context of later periods and cultures, the NISP % of horses from MBA assemblages in Hungary show that they are comparable in terms of the general numbers of horses present on settlements

that use and breed horses. The Roman data shows that towns typically have fewer horses present than military forts or rural settlements or farmsteads, where veterans were often given land and have been determined to breed horses for sale to the Roman Army (Groot 2008; Groot et al. 2009).

Based on the relative abundance of horses in the domesticated taxa during the Hungarian Bronze Age, compared with later periods of known equestrians and specialized horse breeders, I tentatively suggest that sites with roughly 5% of the NISP in horses may be considered a potential location for specialized horse breeding. Sites with greater than 10% should be considered as likely centers of horse breeding. Sites with greater than 15% should be considered probable centers of horse breeding and trade. These suggested NISP % numbers for specialized horse breeding have to be considered in context with the other forms of analysis that follow, but may provide a way of first determining what constitutes specialization in horse production. Based on the numbers and distribution, there were horses in sufficient numbers in the whole of Hungarian Bronze Age to be able to breed them for use and potentially in surplus for exchange (Figure 5.6).

Period	NISP % Horse Average
EBA	9.65 %
MBA	4.91 %
LBA	3.77 %
IA	5.91 %
Roman (Hungary only)	9.98 %

Table 5.6. Mean NISP % of Horses from All EBA, MBA, LBA, IA and Roman Sites in Hungary.

Defining a Surplus of Horses

However, what constitutes a surplus in terms of horse production has not previously been defined, and is difficult to calculate other than very generally. “A comparison between the possible production and the needed quantities to support the local population can demonstrate whether surplus production was possible at all, and give some impression of its scale” (Groot and Lentjes 2013:14). Production for both use in herding of other livestock and raiding/warfare is considered here. Consideration is also given to ‘primary production’ (meat and carcass). Horses were multipurpose animals in the Bronze Age of Hungary to be sure (Chapter 6). Constructing ‘living stock’ profiles is challenging and can be problematic methodologically (Koryakova and Hanks 2006). However, there are other possible ways to approach determining what may be surplus horses. Three areas of information are available to assist with an educated calculation of ratios of people to horses, and thus how many horses could be surplus to that number: ancient state militaries, sites with population estimates of both people and horses, and cross-cultural examples.

Written records from roughly contemporaneous militaries of states in the ancient world, show the Mittani with 1:6.7 to 1:9 horses (as pairs in chariots) per infantry, the Hittites at 1:5 horses (as chariot pairs) per infantry, and Alexander III’s military campaigns in Ancient Greece with 1:6 horses per infantry (Hyland 1990). These of course are empires with highly developed military forces with some of the largest chariot and cavalry corps ever raised, but they illustrate a rough picture of the desired number of horses to people for military use at the highest level. The LBA battlefield at Tollense, Germany has a 1:26 ratio of horses to people (Price et al. 2017). This was a battlefield without an associated settlement, but this battle was most certainly conducted by peoples of *much* smaller non-state polities or groups. A battlefield could potentially exhibit the

highest concentration of people to horses present in a society, much higher than a regular settlement, since ostensibly this would be a primary use of horses and represents their primary deposition at Tollense. The state of preservation at this site is excellent, with very little preservation bias, and shows men actually died on horseback there. From the military contexts above, there is a warfare/raiding range of 1:5 to 1:26 horses per person.

Sites where both population estimates of people and horses are required for anything above broad speculation, and these are exceedingly uncommon. At EBA Bell Beaker Albertfalva, given a population estimate of the village at 50-60 people (Endrődi and Reményi 2016a:87) and an MNI of horses at 71 (Lyublyanovics 2016:205), there is more than one horse per person, an estimate of between 1.18 and 1.42 horses per person. There were certainly more than enough horses at Albertfalva to produce a surplus for use as both primary (meat/carcass) and secondary (riding/draught) use and exchange. This production scenario is certainly possible given the evidence for long distance trade in obsidian, flint tools, and pottery, and the subsequent diffusion of horses to adjacent and contemporaneous Late EBA and Early MBA communities, such as the Nagyrév at Százhalombatta-Földvár (Endrődi 2013; Endrődi and Reményi 2016a; Heyd 2014; Patay 2013).

Establishing an Estimated Living Stock of Horses

Based on Vretemark's (2010) calculations of the living stock at the tell settlement Százhalombatta-Földvár, and the relative frequency of domesticated taxa and MNI, I calculated a conservative estimate of 20 horses per the 310 people of the MBA Benta polity livng at the tell settlement, giving a ratio of 1:15.5 horses to people. The tell settlement of Százhalombatta-Földvár

has a higher number, nearly double, of people to horses than the LBA battlefield site of Tollense. Százhalombatta-Földvár does not have the greatest number of horses of settlements of the MBA, but there were probably just enough present in the MBA to breed for personal use and for exchange on a small scale, if the terms are how many horses are needed to mount a retinue of warriors.

In terms of how many horses are needed to herd the animals at Százhalombatta-Földvár, a mix of pedestrian herding with dogs and mounted herding is assumed, given the grazing characteristics of each species, the likely need to pasture them at varying distances as pasture productivity varied with stocking rates, and the different ways to herd each species. Pigs are excluded from the calculation, as they are generally herded on foot or left to forage in forests. Anthony (2007:221) gives estimates of pedestrian shepherds and dogs able to herd about 200 sheep, while mounted herders with dogs are able to move 500 sheep. With Vretemark (2010:167–168) estimating the 2820 meat and wool sheep and goats and 180 cattle as the yearly living stock for Százhalombatta-Földvár, each horse could have been responsible for 150 animals, not counting pedestrian herders. This amount is 350 less animals than Anthony estimates as the maximum limit possible for a mounted herder. Historic cattle drives of the United States give a ratio of 1 cowboy to 300 cattle, when moving cattle thousands of miles (Malone 1977). Shnirelman et al. (1996) found that modern Kazaks have 2-3 skilled herders to move 400-600 cattle and horses.

In the Bronze Age of Hungary, because they were sedentary animal agriculturalists tethered to settlements and permanent water sources, people probably moved their livestock to the same pastures daily or seasonally, rotating them as they became overgrazed. The potential for cattle loss was much reduced comparatively, e.g. few mounted herders were needed for established, short routes as livestock remember routes to regular pastures. Additionally, pedestrian shepherds could

have complemented mounted herders, and herds may have been split and tailored for the specific makeup of the shepherding ‘crew’. In addition to moving livestock, shepherds were likely tasked with protecting livestock from theft and predation.

Estimating what would be considered a surplus number of horses in Bronze Age Hungarian polities is not straightforward. That said, bearing in mind the uses of horses in herding and in raiding or warfare likely overlapped, there is evidence that the number of horses in EBA Hungary was more than adequate to breed for use with a significant amount of surplus. In the MBA, there were enough horses to breed for use with a small amount of surplus possible for exchange. Ultimately this pattern seems to suggest that surplus production for exchange was quite possible in the EBA and possible at a smaller scale in the MBA. In Hungary, intensification of horse breeding was observed in the EBA BB-Csepel Group with high levels of horse breeding through the period, but this was not obviously replicated through the course of the MBA. The important exception to note here is at the Maros/Perjámos Romanian settlement of Pecica-*Şanțul Mare*, where breeding and ritual exploitation of horses increased significantly from 2.4 % NISP before 1900 BC to 30% between 1820-1770 cal BC, before declining to 5.4% between 1720-1500 BC (Nicodemus 2014). Interestingly, horse breeding reaches peak intensity *before* peak metallurgical production and settlement expansion, perhaps revealing a clue that horses were key to obtain ores and thus intensify metallurgical production. This settlement likely indicates a major breeding and dispersal center for the MBA in the southeast of the Carpathian Basin, with contacts to southeastern Europe. It also is the only site that has clear linkages between intensification of horse breeding, metallurgy, and settlement expansion.

Determinging Equestrian Specialists

Differentiating between full-time and part-time specialists in horse breeding and production is mostly speculation, but a worthwhile exercise. If horse breeding and production for trade was practiced into the MBA, it was probably done so by part-time specialists, perhaps lineages or groups of related kin, who were also herders that protected settlements somewhat along with their livestock. There was probably a segment of society who were equestrians that bred, cared for, trained, herded with, fought on, and were involved in the exchange of horses. The rather small scale of production and potential for exchange in horses suggested by the data so far here is like the scale of pottery, tool, and metal production at sites throughout MBA Hungary with localized production by part-time specialists and local, regional, and some long distance exchange. Maybe some people were full time stockbreeders who herded their livestock on horseback and were part-time horse breeders and trainers who also fought on horseback. Equestrian specialists may be like craft producers and metallurgists in Bronze Age Hungarians societies, where knowledge of a craft or metallurgy could have been held by particular kin groups or lineages, but was practiced in addition to their subsistence agricultural labors (Kiss and Fischl 2015; Kienlin and Stöllner 2009; Sofaer et al. 2010).

Cross-cultural data of equestrian cultures shows that breeding, daily care, training, veterinary care, tack making, and organization of horses for gift or exchange was conducted via family groups and lineages (Kanne 2006). These practices were undertaken and divided among family members along age, gender, and kin ties. There is a fundamental difference in producing a ‘living’ product like a trained horse for exchange rather than a material one requires a substantive and difference of intensity in daily practice and production. It wholly overlaps with what would

be considered a full-time subsistence occupation of stockbreeding. In this sense, equestrians may have been like full-time specialists because of the nature of their labors and end products. In either case, because of the knowledge and skill required by horse husbandry, and especially training and use, there were probably equestrian specialists in Bronze Age Hungary.

Identifying Breeding Populations and Production Goals: Age Profiles

The possibility of specialization in horse breeding is confirmed above by the relative frequencies of horses from Bronze Age settlements in Hungary. The potential for surplus and for specialists is suspected by calculating ratios of horses per person. The presence of full breeding populations with specific production orientations is used here to further deduce if the production of surplus animals for exchange was possible. Reitz and Wing (2008:178-179) find that age classes are suggestive of how animals were used by populations and can provide information about their production and exchange. “The analysis of age-at-death data, derived from epiphyseal fusion and dental eruption/wear patterns, is one of the most powerful tools at the disposal of zooarchaeologists studying past hunting and herd management practices” (Price et al. 2016:157). Generally, local production and herd management strategies can be deduced from examining mortality profiles of domesticated animals. To determine export production versus import production, a wide range of ages present (a full breeding population) in an assemblage indicates the production of animals at a site while a restricted age range would point towards importation or export. Herd management strategies such as using animals primarily for their meat/carcass or their secondary products are also understandable via analysis of their age classes at death (Marciniak 2005; 2011).

Materials and Methods for Determining Age-at-Death in Horses

Age in horses is determined by epiphyseal fusion, cheek-tooth (premolars and molars) measurements, and incisor wear (Levine 1982; Martin 2010). Epiphyseal fusion can only provide very general age information. Between nine months and 3.5 years, most of the epiphyses in a horse's skeleton are fused (Evans et al. 1994). If there are no teeth present in an assemblage, general age can be determined between adult and subadult. Teeth are by far the preferred method of ageing horses in archaeological samples. Eruption rates are well known, so the presence of particular teeth can give a good estimate (Martin 2010:iv). The appearance and shape of the incisors is a well-known method of ageing live horses still used by veterinarians, which can also be applied to archaeological samples. Ageing by cheek-teeth, by measuring height of the crown minus the root, is the most common method used by archaeologists. There is a known correlation between the height of the cheek-teeth and age (Levine 1982).

I used all three methods (epiphyseal fusion, cheek-teeth height, and incisor wear) when I examined horse bones from assemblages collected from Dunakeszi-Székes-dűlő, Százhalombatta-Földvár, Királyok Útja 293, Bakonszeg-Kádárdomb, Berettyóújfalu-Szilhálom, and Gáborján-Csapszékpart and have included comparative demographic data from contemporaneous assemblages examined by other archaeologists when available. Only ageing by teeth were considered when grouping samples to my five age classes, which I determined based on comparability to my particular samples, the existing data, methods, other domesticated animal age classes, and the typical growth and use classes of horses. My age classes are as follows: 0-4 years, 5-9 years, 10-14 years, 15-20 years, and over 20 years.

Production Goals for the Horses in Bronze Age Hungary

There were full breeding populations of horses with neonates, juveniles, adults, and older adults at the EBA Bell Beaker sites of Albertflava, Csepel Harós, Csepel Hollúndi Ut. The larger number of juveniles (31%) at Albertfalva has been suggested to indicate meat production (Lyublyanovics 2016), but secondary use production for under saddle in herding is also probable given that nearly 70% of the assemblage were adult animals, and a small percentage (0.18%) were older animals. Meat exploitation was more than likely, but secondary uses were probable. The EBA component of the Dunakeszi-Székes-dűlő settlement I analyzed had horses an average age at death of 2.83 years. This seems to be in line with the Bell Beaker-Csepel Group settlement horse demographic distribution.

In the MBA, full breeding populations were present in my sampled sites at the tell settlements of Százhalombatta-Földvár, and Királyok Útja 293. The presence of full breeding populations of horses demonstrates the potential to produce a surplus in horses. The widespread presence of older animals at these two Vatya sites, including those over 20 years of age in some cases, is suggestive of their use as riding or traction animals. The equine assemblage at Százhalombatta-Földvár with many age classes represented is characteristic of horse production that is located at or near the settlement, a clear indication of localized production, which is supported by the archaeological contexts of horse bone finds (Reitz and Wing 2008; Vretemark and Sten 2005). Several sites demonstrate a skew in age classes: younger individuals are overrepresented at Királyok Útja 293 but only older individuals are found at the Berettyó Valley tells of Bakonszeg-Kádárdomb, Berettyóújfalu-Szilhálom, and Gáborján-Csapszékpart (Figure 5.1).

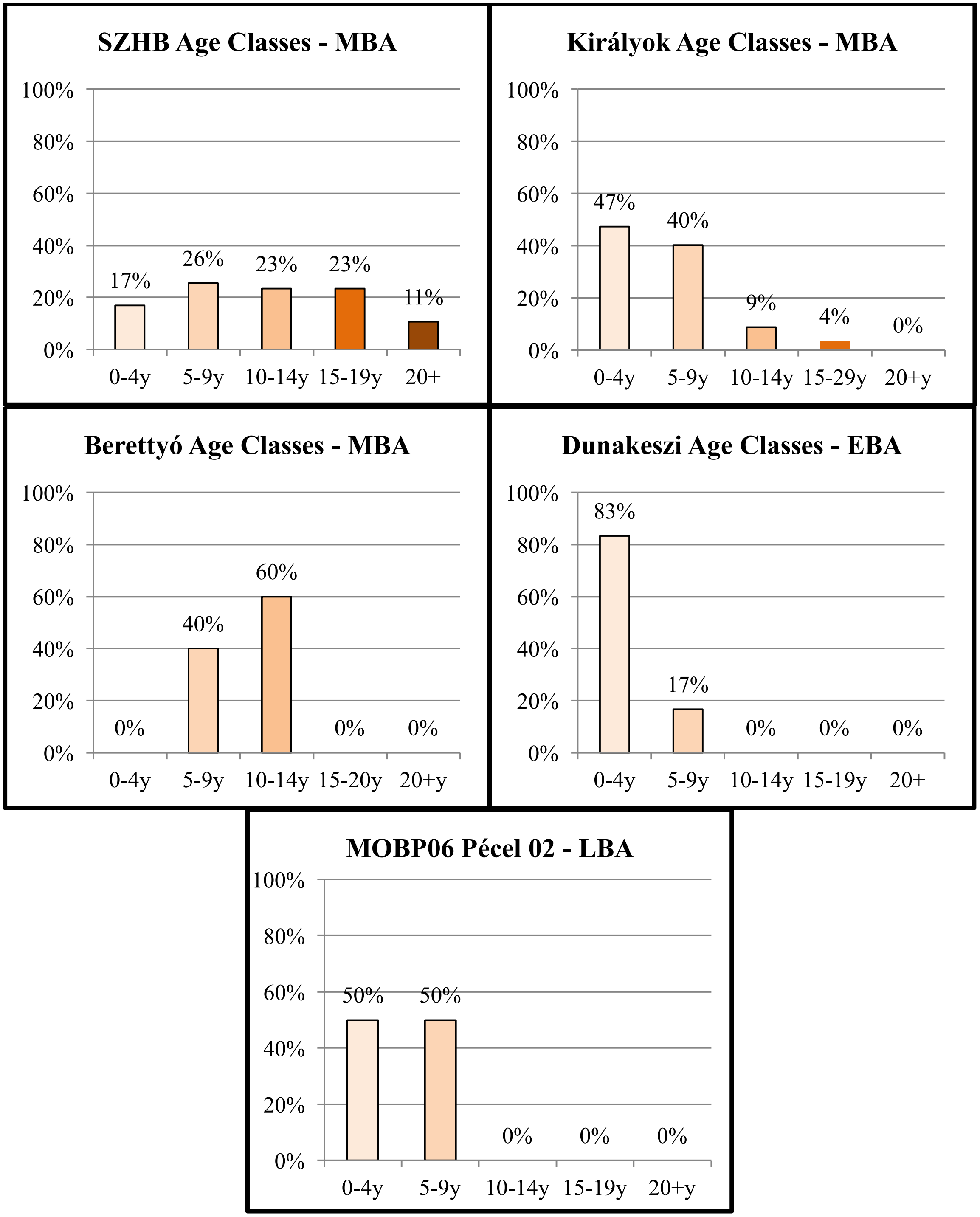

Figure 5.1. Age Classes of Horses Compared Between Bronze Age Hungarian Settlements.

These Berettyó Valley MBA tell settlements have a classic signature of only imported animals with their restricted age range of only older animals. This may negate the above high NISP % that suggested Bakonszeg-Kádárdomb was a center of breeding, and highlights that it may have been a center of import and use.

Reitz and Wing (2008) also state that a population of animals that is produced for export would lack prime-aged animals, and if their production were not directed for consumption, many animals would survive into old age. The Százhalombatta-Földvár sample is suggestive of a population that may be geared for some export and certainly for use beyond meat. There are less horses aged 5-9 than expected present when compared to Roman Era sites like Kesteren (Anthony and Brown 2011; original data from Levine 1990, 1999c). Horses aged 5-9 years are prime-aged animals for exchange because breaking and training for saddle is not generally begun until age 2-3, as the long bones do not completely fuse until roughly age 3.5 (Evans et al. 1994). Most horses are not generally well broke until age 5, especially if they may be only intermittently ridden. Riding use for horses typically extends into the late teens and even twenties, so a reduction of prime-aged animals does not preclude their use as mounts. Rather, it may highlight a pattern of production for exchange. Mares can be reproductively viable until their early twenties, so exchange of prime aged riding horses would not affect the people's ability to continue production of animals for use and surplus animals for export.

The average age at death for horses at in the MBA Százhalombatta-Földvár is 11.2 years and 12 years in the LBA (Table 5.7). This is decidedly older than other contemporaneous and later populations east and west of the settlement where horses typically died between the ages of 4.5 and 10 years (Benecke 1994; 2006; Bertašius and Daugnora 2001; Bökönyi 1968; Lyublyanovics

2006; Vretemark and Sten 2005). The horses from Királyok Útja 293 have an average age at death of 5.42, while the horses from the combined eastern Berretyó Valley sites average aged 10 years at death.

Site	Age at Death Average
EBA Dunakeszi-Székes-dűlő	2.83 years
MBA Királyok Útja 293	5.42 years
MBA Százhalombatta-Földvár	11.2 years
MBA Berettyó Valley Combined	10 years
LBA Százhalombatta-Földvár	12 years
LBA Deer Stone-Khirigsuur	8.82 years
IA Scythian Royal Barrows	14 years

Table 5.7. Average Age at Death of Horses from Bronze Age Hungary and Other Sites.

Transportation Population Profiles Compared

Taylor (2017) has suggested that a transport population, one geared for use under saddle or in draught, will include subadults and horses over the age of twenty, with the majority of animals between 6-15 years. The population of horses from LBA Deer Stone-Khirigsuur Complex in Mongolia (c. 1400-1250 BC), which he identifies as ridden and/or draught horses with a transport mortality profile, has an average age of near 8.82 years at death (Table 5.7 above). The horses interred with people in the Iron Age Scythian royal barrow graves (Benecke 2007), which were most certainly ridden, have an average age of death of roughly 14 years. The horses from the settlement Százhalombatta-Földvár died at an average of 11.2 years in the MBA and 12 years in the LBA. This population of horses from this tell were in all likelihood exploited for their secondary uses, as keeping such a number of mature and old adults would make little sense for a production pattern primarily oriented for meat use. Moreover, because horses can be

reproductively viable through their early twenties, this population could conceivably be able to produce a surplus of animals.

The population distribution from the assemblage at Százhalombatta-Földvár substantiates the proposal by Choyke (2000) and Vretemark and Sten (2005) that the age structure of horses at Százhalombatta indicates that horses were not used primarily as a meat animal by the MBA. Benecke and von den Driesch (2003) determined that populations further eastward on the steppes who continued to utilize horses as a meat supply, had an age distribution skewed towards young animals (30-40%). This is like the populations of the EBA Bell Beaker-Csepel Group sites and quite unlike the population represented from Százhalombatta-Földvár.

Determining Primary Versus Secondary Product Populations of Horses

One of the biggest problems when discussing primary versus secondary products when it comes to horses, is that, "the domestication of the horse appears to be intimately tied together with its exploitation for secondary products, such as milk or traction" (Greenfield 2010:25). Even if horses were exploited largely for meat in the EBA, or evan throughout the Bronze Age, they were probably also ridden and may have been milked. In discussing the primary or secondary products of animals, those with a younger kill-off pattern may suggest an orientation to meat and carcass products. However, the unusual butcher marks and the regular deposition of these individuals in buildings at Királyok Útja 293, hint that these may represent a pooling of younger horses for exchange or perhaps culling for a ritual purpose, as has been demonstrated at Pecica-*Şanţul Mare*. This site also had a good amount of older adult horses, 9-19 years, which likely speaks of their secondary use under saddle or in traction. The eastern tell sites of the Berretyó Valley (Bakonszeg-

Kádárdomb, Berretyóújfalu-Szizhálom, and Gáborján-Csapszékpart) only have adult or older adult individuals (6-18 years).

These three varying patterns of horse age-at-death likely indicate three quite different goals of horse husbandry and use. The Vatya site of Kiralyók Útja 293 may demonstrate an unusual example of age-at-death perhaps related to gathering younger animals for training and trade, especially when considering its position north of Százhalombatta-Földvár, and that its (now dry) river valley circumvented the Danube Bend. The Eastern Gyulavarsánd Tells only have mature adult horses, which suggests they were imported for use already trained. The heterogeneity of horse age-at-death mirrors the heterogeneity in the animal production practices and uses of the Bronze Age of Hungary. The age classes of Bronze Age horses are further suggestive of the potential surplus production of horses for exchange, and of the secondary uses of horses, for riding or draught.

Identifying Local Production and Exchange: Strontium Isotopes ($^{87}Sr/^{86}Sr$)

A key step in identifying specialization and trade in horses in Bronze Age Hungary is to establish where the horses were born. Local, specialized breeding would indicate the role of horses as a potential trade good and thus establish the possibility they were commodities for political economies. If some horses were born non-locally, trade in horses would be expected. If all horses were non-local, their import from another area would be suspected. Some scholars have refuted the idea that horses were bred locally during the Hungarian Bronze Age, and that most were imported from the steppes (Drews 2004; 2017). While the previous chapters have allayed those assertions, documenting the introduction of horses by the Copper Age and large populations with

full breeding populations by the EBA, stable isotopes analyzed from Bronze Age horses can finally put those rather 'classicist' preconceptions to rest. Moreover, stable isotopes document patterns of intraregional, extraregional, and supraregional trade of horses by identifying if they were born in the area under study, in this case Hungary.

About Strontium Isotopes ($^{87}Sr/^{86}Sr$)

Of the stable isotopes, strontium isotopes specifically are the most reliable and effective measures to determine local versus non-local place of birth and to infer patterns of trade (Bentley et al. 2013; Price et al. 2017). Strontium isotopes have successfully been used to identify local versus non-local residents and patterns of mobility in both people and animals from archaeological sites. Radiogenic strontium is especially suited to document the same for horses of the Hungarian Bronze Age. Strontium isotope analyses have been undertaken both within Hungary (Bentley et al. 2004; Giblin 2009; Giblin et al. 2013; Gerling et al. 2012a, 2012b; Gerling 2015; Price et al. 1998; Whittle et al. 2013) and surrounding countries (Bentley 2007; Bentley et al. 2003, 2004, 2013; Bentley and Knipper 2005; Price et al. 2001; Price et al. 2017) and with horses (Bendrey, Hayes, and Palmer 2009).

Strontium isotopes are present the Earth's crust and vary with the age and type of rock due to the nature of the radioactive decay of rubidium (Faure 1986). ^{87}Sr is radiogenic and a product of the radioactive decay of ^{87}Rb, ^{86}Sr is not. ^{87}Rb decays at a constant rate to ^{87}Sr, so ^{87}Sr can be used to measure the age and source of varying rock formations. To normalize variation in strontium content in natural materials, the isotope value is expressed as a ratio, ^{87}Sr/^{86}Sr, as ^{86}Sr is closest in approximate abundance to ^{87}Sr (Price et al. 1994).

Differences in $^{87}Sr/^{86}Sr$ are recorded in human and animal skeletal tissues and indicate differences in underlying bedrock geologies when the skeletal tissues are formed. Strontium isotope ratios in tooth enamel are indicative of a person's or animal's place of birth (Beard and Johnson 2000; Price, Burton, and Bentley 2002). As the enamel in the tooth is formed, it records the local level of strontium in the individual's diet. As such, strontium ratios of teeth reflect the local geology where the tooth is mineralized. In horses, tooth enamel is mineralized between the first 0.5 – 55 months of the animal's lifetime, roughly from just after birth to just over 4.5 years of age (Bendrey, Hayes, and Palmer 2009:142; Hoppe et al. 2004:Table 2).

Establishing the geological setting for archaeological samples is necessary to identify local strontium isotope ranges. Hungary has three distinct regions with varying underlying bedrock geology and $^{87}Sr/^{86}Sr$ ratios: Transdanubia (west of the Danube River), the Northern Mountains that encircle the country, and the Great Hungarian Plain (east of the Danube River). Generally, the older the underlying bedrock and soils, the higher the strontium isotope values will be. Various locations throughout Hungary and Central Europe have published in previous studies and are used to establish geological variability in strontium isotope means and ranges in the region surrounding the study area (mapped in Figure 5.2 and shown in Table 5.8).

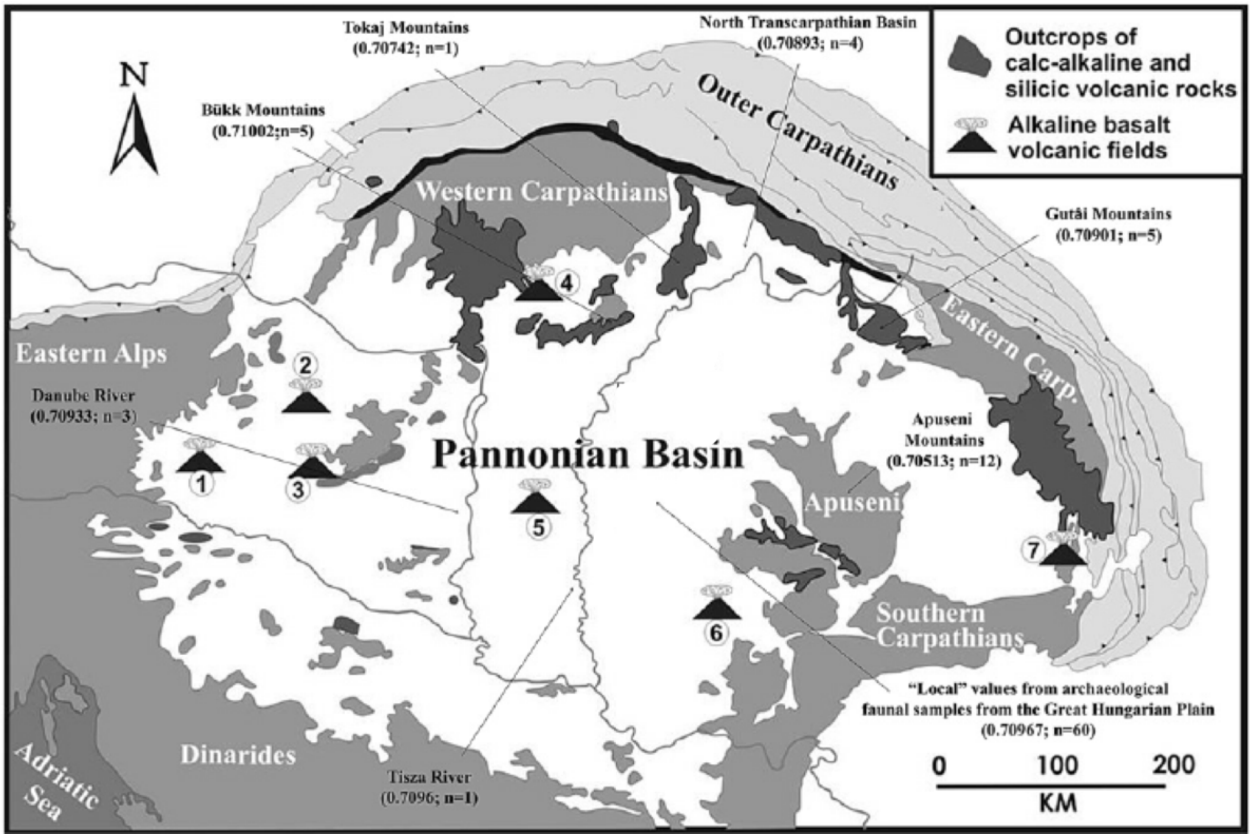

Figure 5.2. Map of $^{87}Sr/^{86}Sr$ Means in Hungary and Central Europe (modified from Giblin et al. 2013:230, Figure 1).

Site	$^{87}Sr/^{86}Sr$ Mean	Source
Aspuseni Mountains	0.70513	Seghedi et al. (2004); Giblin et al. (2013)
Tokaj Mountains	0.70742	Seghedi et al. (2004); Giblin et al. (2013)
Gutâi Mountains	0.70901	Seghedi et al. (2004); Giblin et al. (2013)
North Transcarpathian Basin	0.70892	Seghedi et al. (2004); Giblin et al. (2013)
Bükk Mountains	0.71002	Giblin et al. (2013)
Danube and Tisza Rivers	0.70940	Palmer and Edmond 1989; Price et al. 2004; Giblin et al. 2013
Körösladány-Bikeri	0.70938	Giblin (2009); Giblin et al. (2013)
Vésztő-Mágor	0.70990	Giblin (2009); Giblin et al. (2013)
Vésztő-Bikeri	0.70981	Giblin (2011); Giblin et al. (2013)
Polgár-Piócási-dűlő	0.70967	Giblin (2011); Giblin et al. (2013)
Abony 36	0.70940	Giblin (2011); Giblin et al. (2013)
Sárrétudvari-Őrhalom	0.71032	Gerling et al. (2012)
Balatonszárszó-Kis-erdei-dűlő	0.70923	Whittle et al. (2013)
Mezőkövesd-Mocsolyás	0.70986	Whittle et al. (2013)
Füzesabony-Gubakút	0.71021	Whittle et al. (2013)
Tollense Valley, DE	0.71190	Price et al. (2017)
Vedrovice, CR	0.71111	Bickle and Whittle (2013)
Aiterhofen, DE	0.70951	Bickle and Whittle (2013)
Ensisheim, FR	0.70925	Bickle and Whittle (2013)
Souffelweyersheim, FR	0.70886	Bickle and Whittle (2013)
Kleinhadersdorf, AT	0.70991	Bickle and Whittle (2013)
Schwetzingen, DE	0.70979	Bickle and Whittle (2013)
Nitra, SK	0.70947	Bickle and Whittle (2013)

Table 5.8. Average $^{87}Sr/^{86}Sr$ Values for Areas within Hungary.

Materials and Methods

The enamel from horse teeth was sampled from seven archaeological sites spanning the EBA to the LBA, with three sites on the Danube: Dunakeszi-Székesdűlő (EBA), Királyok Útja 293 (MBA), and Százhalombatta-Földvár 27/2 (MBA/LBA); one site just west of the Danube: MOBP06-Pécel02 (LBA); and three MBA sites in the Berettyó River Valley: Bakonszeg-Kádárdomb, Berettyóújfalu-Szilhálom, and Gáborján-Csapszékpart (Figure 1.1). This selection of sites provides useful comparisons of horse production within regions and between them and throughout the course of the Bronze Age. These sites fall within cultural traditions that are

especially comparable in the MBA between Vatya and Gyulavársand polities. Enamel samples from 29 horse teeth (Table 5.9.) were analyzed for strontium concentration and isotope ratio. Molars and premolars were sampled. Samples were submitted to Geochron Laboratories of Chelmsford, MA and were processed and analyzed according to their standard procedures and in accordance with methods described by Bendrey et al. (2009) and Giblin (2009).

Site	Date	Accession	Tooth	Upper/ Lower Jaw	Side	Age	$^{87}Sr/^{86}Sr$
Bakonszeg-Kádárdomb	MBA	1	M3	Upper	R	11-12 y	0.709413
Berettyóújfalu-Szilhálom	MBA	11	M2	Lower	R	9-11 y	0.710910
Dunakeszi-Székesdűlő	EBA	101	M3	Upper	L	>3 y	0.709327
Dunakeszi-Székesdűlő	EBA	396	P3	Upper	R	<3 y	0.709312
Gáborján-Csapszékpart	MBA	77.486	M2	Upper	R	5-6 y	0.710354
Gáborján-Csapszékpart	MBA	77.485	M2	Upper	L	12-18 y	0.710705
Gáborján-Csapszékpart	MBA	77.550	M1	Upper	L	12-18 y	0.710158
Királyok Útja 293	MBA	912	M1	Lower	R	6-7 y	0.709457
Királyok Útja 293	MBA	1591	M2	Upper	L	7-8 y	0.709389
Királyok Útja 293	MBA	709	M2	Upper	R	7-8 y	0.709574
Királyok Útja 293	MBA	1153	M2	Upper	L	9-10 y	0.709639
Királyok Útja 293	MBA	1685	M2	Lower	R	6-7 y	0.709396
Királyok Útja 293	MBA	2102	M2	Lower	L	7-8 y	0.709561
Királyok Útja 293	MBA	1701	M3	Upper	L	6-7 y	0.709218
Királyok Útja 293	MBA	34	M1	Lower	L	14-15 y	0.709612
MOBP06-Pécel02	LBA	1180.1	M1	Upper	R	4-5 y	0.709485
MOBP06-Pécel02	LBA	1180.2	P3	Upper	R	2-7 y	0.709703
Százhalombatta-Földvár 27/2	MBA	2438	M1	Upper	L	6-7 y	0.709290
Százhalombatta-Földvár 27/2	MBA	967	M2	Upper	L	7-8 y	0.710357
Százhalombatta-Földvár 27/2	MBA	2079	M2	Lower	L	15-16 y	0.710641

Százhalombatta-Földvár 27/2	MBA	2158	M2	Lower	R	6-7 y	0.710693
Százhalombatta-Földvár 27/2	MBA	890	M3	Upper	L	12-13 y	0.709434
Százhalombatta-Földvár 27/2	MBA	2702	M3	Upper	R	9-10 y	0.709560
Százhalombatta-Földvár 27/2	MBA	2027	P3	Lower	R	> 8-9 y	0.709487
Százhalombatta-Földvár 27/2	MBA	2074	P3	Lower	R	3-4 y	0.709421
Százhalombatta-Földvár 27/2	MBA	2147	P3	Upper	L	6-7 y	0.709420
Százhalombatta-Földvár 27/2	MBA	2210	P3	Upper	L	11-12 y	0.709865
Százhalombatta-Földvár 27/2	LBA	734	M2	Lower	L	16-17 y	0.709565
Százhalombatta-Földvár 27/2	LBA	625	M3	Upper	R	6-7 y	0.709310

Table 5.9. Teeth Sampled for Strontium Isotope $^{87}Sr/^{86}Sr$ Analysis.
Site, Time Period, Accession Number, Specific Tooth Sampled, Age-at-Death and $^{87}Sr/^{86}Sr$ Value for the Individual are Shown.

Results of the Strontium Isotope Analysis and Implications for Trade in Horses

The results show an $^{87}Sr/^{86}Sr$ mean for the 29 teeth sampled of 0.70973, with a range of 0.7087 – 0.7102 within a 2-sigma std error, long term reproducibility of NBS-987: 0.710240 +/- 0.000014 (2-sigma). The mean is nearly identical to Giblin's (Giblin 2009, 2011; Giblin et al. 2013) reported mean of 0.70967 for sites from the Great Hungarian Plain. My range is within what has been determined as the 'loess local' signature of Central Europe at 0.7085 – 0.7104 identified by Bentley et al. (2012), Hedges et al. (2013), and Whittle et al. (2013). As with the previous authors, $^{87}Sr/^{86}Sr$ values outside of the local range are considered to be from individuals reared on uplands with bedrock geologies of higher $^{87}Sr/^{86}Sr$ values.

The results indicate that the horses from Királyok Útja 293 (KU), Dunakeszi-Székesdűlő (DS), MOBP06-Pécel02 (MP), and Bakonszeg-Kádárdomb (BK) all grazed locally at the time

their teeth were mineralized, between birth and 4.5 years (Table 5.9, Figures 5.3 and 5.4). This means they were born at or near these settlements. Most of the horses from Százhalombatta-Földvár (SZHB), nine of twelve sampled or 75%, were born and raised locally to that settlement, while all the horses from Berettyóújfalu-Szilhálom (BS) and Gáborján-Csapszékpart (GC) grazed or were foddered from plants on geologies with a higher radiogenic content when they were young. This reveals that three horses from the MBA at Százhalombatta-Földvár and four horses from the Berettyó Valley (BR) tells were reared in places outside of the Carpathian Basin. The EBA and LBA sampled teeth were all from horses reared locally. The 'local' horses from Százhalombatta-Földvár and the horses from the other sites on the Danube (Királyok Útja 293, Dunakeszi-Székesdűlő, MOBP06-Pécel02) cluster tightly together within 0.003 of each other. The seven 'non-local' horses from Százhalombatta-Földvár, Berettyóújfalu-Szilhálom, and Gáborján-Csapszékpart are within 0.002 of each other.

Horses were brought into Százhalombatta-Földvár, Berettyóújfalu-Szilhálom, and Gáborján-Csapszékpart in the Berettyó Valley as mature adults from non-local areas of higher radiogenic bedrock geologies. Their age at death range from 6-18 years. Trade in horses in the MBA is strongly suggested because these non-local outliers are clustered together significantly outside the local range. Pinpointing the exact origin of non-local horses is not possible with $^{87}Sr/^{86}Sr$ analysis, but these non-local horses cluster with samples taken from Hungary closest to the Bükk Mountains, or north of the Danube in areas of higher $^{87}Sr/^{86}Sr$ values (Figure 5.4).

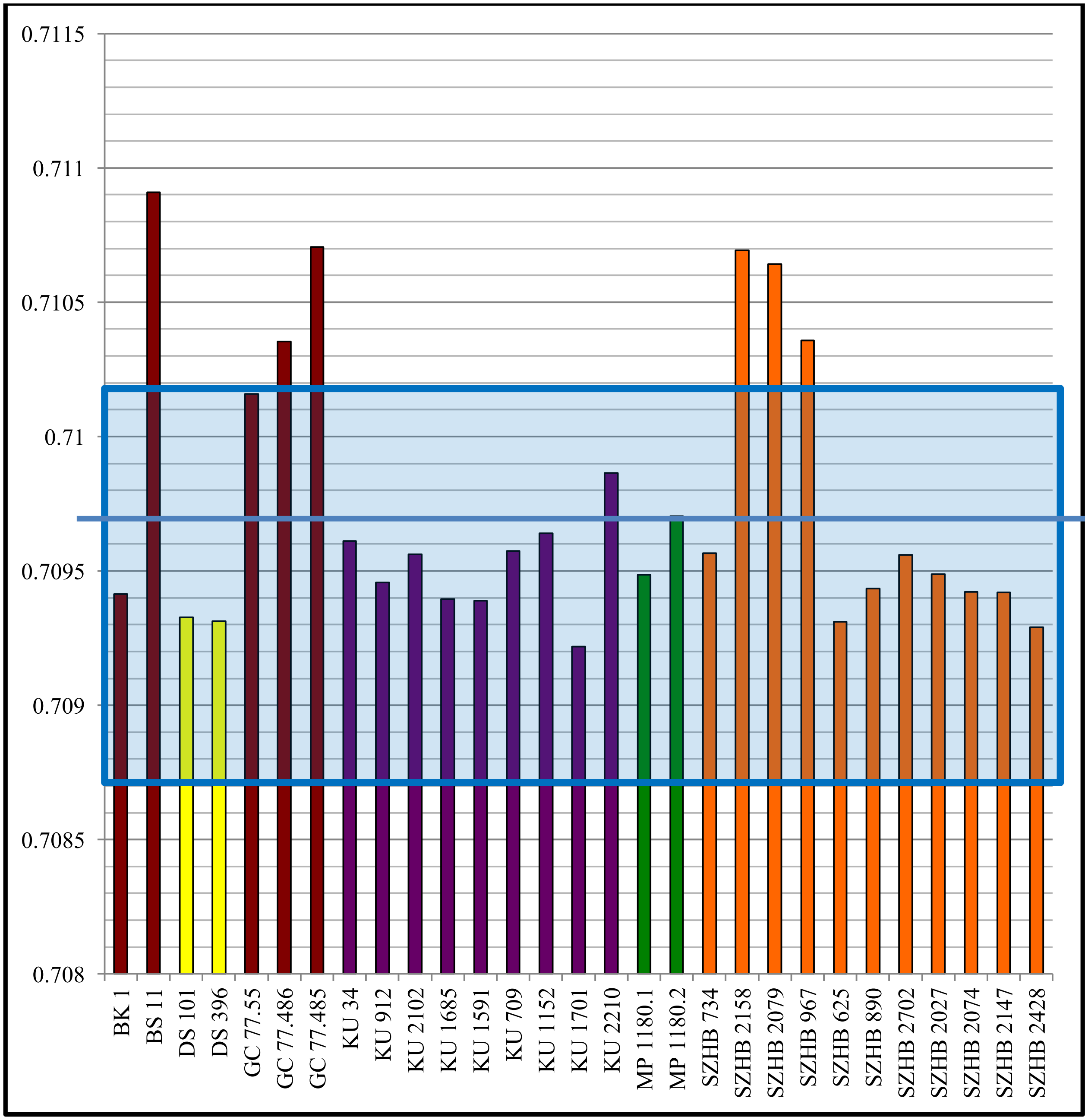

Figure 5.3. Bar Graph of $^{87}Sr/^{86}Sr$ Results on Horse Teeth from Seven Sites from Bronze Age Hungary. The blue line marks the mean of 0.7097. The blue box shows the range within two σ between 0.7087 and 0.7102.

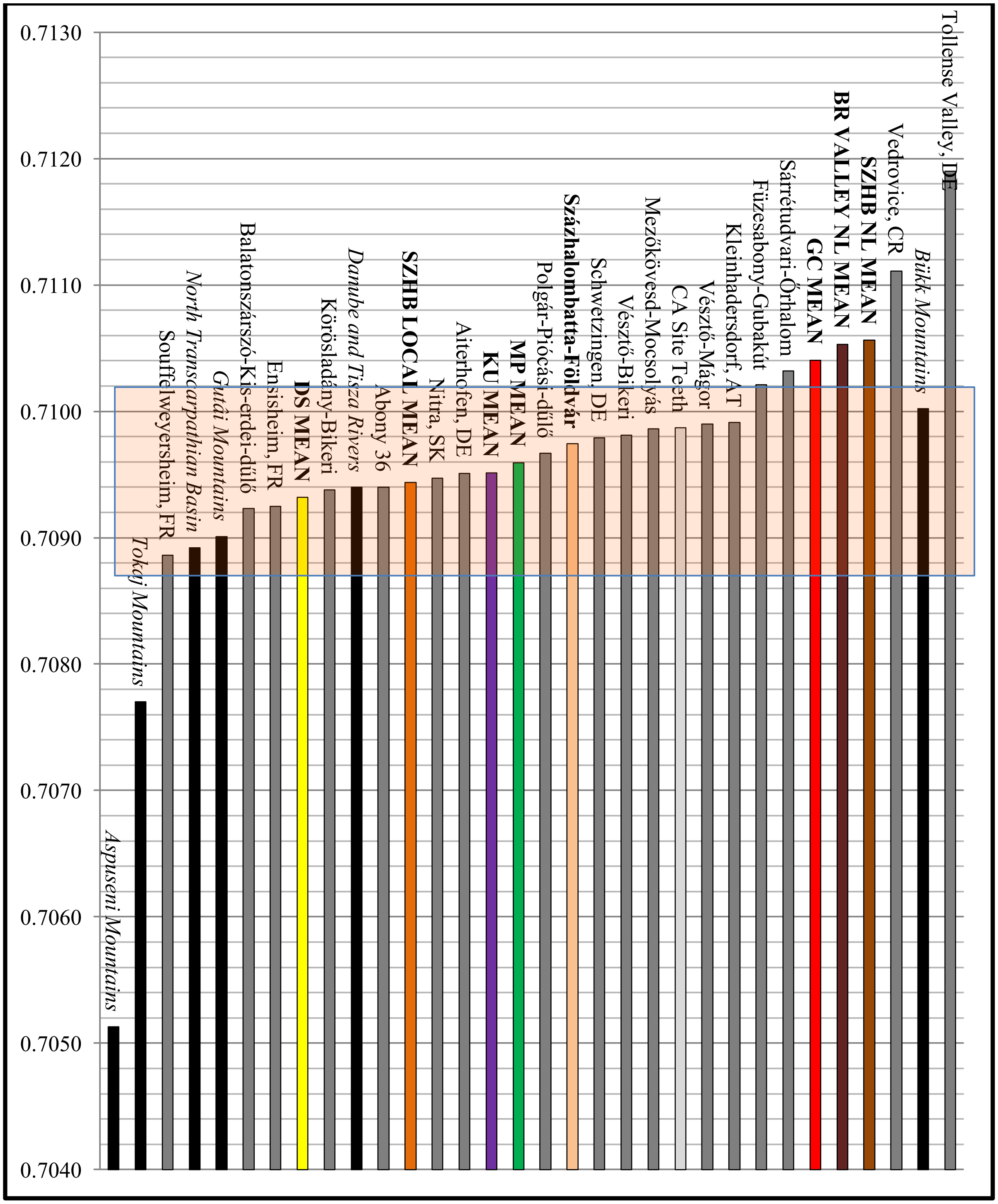

Figure 5.4. Mean Values of $^{87}Sr/^{86}Sr$ from European and Hungarian Sites. Local $^{87}Sr/^{86}Sr$ Highlighted by Red Box.

I suspect a possible trading relationship between people from the large Füzesabony/Otomani tell settlements, such as Füzesabony-Öregdomb and Tószeg-Laposhalom, the Vatya settlement of Százhalombatta-Földvár, and the Gyularvarsánd settlements of Berettyóújfalu-Szilhálom, and Gáborján-Csapszékpart. All had appreciable numbers of horses and all had bit finds with related forms and designs. A Füzesabony/Otomoni 'origin' the 'foreign' horses in my study is one possible scenario, given its position near the Bükk Mountains and with the closest $^{87}Sr/^{86}Sr$ ratio to the non-local horse mean, and its high concentrations of bits. Interestingly, Hüttel (1981) classified a Füzesabony type bit with distribution into Transylvania and Slovakia, near to the Bükk Mountains. The Füzesabony type is also quite similar to the bits from Százhalombatta-Földvár, which Hüttel noted. A corridor of trade between these three regions could have connected horses, bits, and copper ores from the Eastern Alps, to the Slovakian Ore Mountains, and the Transylvanian Ore Mountains (Chapter 4, Figure 4.18).

In sum, three MBA Hungarian tell settlements from two different cultural regions have non-local horses present. These horses were born and raised on bedrock geologies of uplands, perhaps close to the Bükk Mountains. In the case of Százhalombatta-Földvár, these horses came from quite a distance. Given the results of the $^{87}Sr/^{86}Sr$ analysis, there is a strong case for both localized production of horses in the EBA, MBA, and LBA at sites around the Danube Bend, and trade in some non-local horses in the MBA. Some exchange of horses clearly occurred during the MBA of Hungary.

Identifying Selection of Particular Traits in Horses

Specialization in horses and use goals may be indicated by selection for particular traits within a population, such as larger size, more robust or slender individuals, or certain colors. Manipulation of phenotypic traits of horses, such as color, size, and conformation (shape), are the earliest and most common traits that horse breeders attempt to alter (Librado et al. 2016, 2017; Makvandi-Nejad et al. 2012; Schubert et al. 2014). What horses are to be used for and their performance ability in such tasks are the more complex traits that breeders commonly work to produce by manipulating the observed characteristics of their breeding populations. Cross-cultural, archaeological, historical, and genetic data all speak to continual human selection for these basic phenotypic traits through time and across cultures. In addition, aspects of tameablity that were initially part of the domestication process, continue to be selected for long after domestication occurred, which have to do with the retention of juvenile characteristics that make animals more manageable (Librado et al. 2016).

Genetic Research of the Selective Breeding of Horses in Prehistory

Recent genetic research has established that selective breeding of horses occurred during the process of domestication, via evidence for the selection of particular coat colors in horses that went with it (Ludwig et al. 2009). Wild horses were probably dun in color, then bay and black. By 3000 BC, additional colors appear, including chesnut, which rises to about 28% of the coat colors found in the Bronze Age, and spotted patterns of Sabino and Tobiano (Figure 5.5). This proliferation of coat colors has given substantiation to the archaeological evidence that indicates horse domestication happened by 3500 BC at the latest (Outram et al. 2009), because there was,

"A rapid and substantial increase in the number of coat colorations is found in both Siberia and East Europe beginning in the fifth millennium B.P." (Ludwig et al. 2009:485). Horses from the Bronze Age of East Europe show another period of increased selection for coat colors. "Sabino is the first spotting phenotype, appearing during the fifth millennium B.P. in Siberia, and present in Armenia and Moldavia during the Middle Bronze Age. The Tobiano spotting was first found in a single Eastern European sample (3500 to 3000 yr B.P.)" (ibid). With large splashes of white on solid coats, Sabino and Tobiano are commonly referred to as "paint" colored horses in the United States. An additional coat color preference, complex leopard spotting (commonly associated with Appaloosa horses in the United States who are spotted with different patterns), was artificially selected for in horses recovered from Kirklareli–Kanligecit (Turkey: 2700–2200 BC), then selected against in the MBA/LBA, and reintroduced in the Iron Age (Ludwig et al. 2014). This coat color has a genetically associated vision disorder, congenitally stationary night blindness, which can make horses difficult to handle in low light. The presence of this vision disorder with leopard spotted coats may have caused breeders to eliminate it from their stock. "Thus, the phenotypic and breeding preferences of early horse breeders seem to have changed over time, just as the preferences of animal breeders change today" (ibid:7).

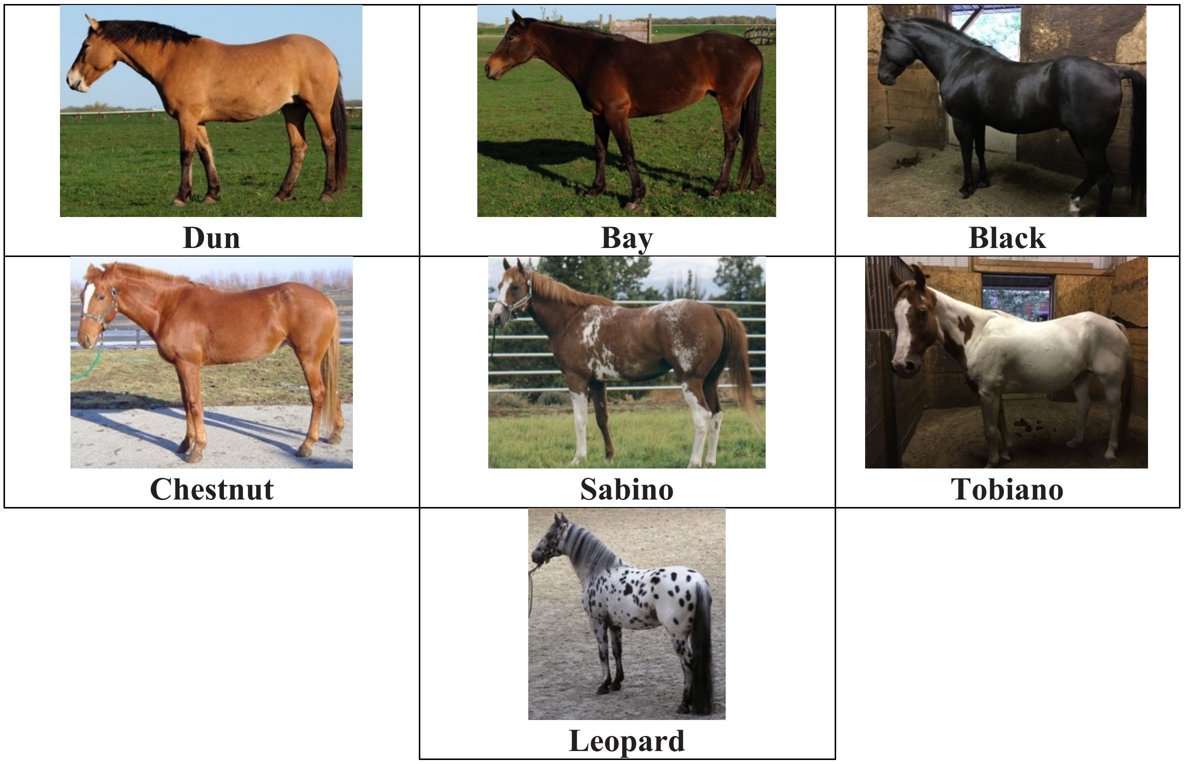

Figure 5.5. The Coat Colors of Horses Discussed.

Further genetic research establishes that by the Iron Age, people were selectively breeding horses for a multitude of desired characteristics. Iron Age Scythian horse breeders on the Eurasian steppes (600-3000 BC), favored horses with a diversity of endurance and speed potentials (with the so-called *speed gene*), stockier individuals with thicker forelimbs, improved dairying ability and water retention, and more coat colors (Librado et al. 2017). Interestingly, people also appeared to have a keen interest in keeping a large genetic breeding pool, as out of 11 horses tested in the Pazryk Kurgan at Berel', only two were related, bearing the same mitochondrial haplotype but different y chromosomes, meaning they were out of related mares by different stallions. The authors suggest that these two individuals may represent the progeny of valued pedigrees. Perhaps the import of some horses during the MBA of Hungary indicates that this genetic variability was

valued strongly in horse breeding practices quite early.

The genetic data establishes the presence of human manipulation of the coat color, size, conformation, and performance ability of horses since their domestication, with punctuations in favored characteristics that varied through the Bronze and Iron Ages. Turing to what can be inferred about selective breeding in horses from archaeological data, biometric changes observed in archaeological horse bones may be evidence of a new type of horses, specifically bred for different uses and for exchange. Size and shape in horses are rather more simple traits for people to manipulate. “This finding supports a model of horse evolution in which divergence and genetic differentiation according to body size occurred early and was subsequently followed by creation of breed lines” (Makvandi-Nejad et al. 2012:2–3).

Quantifying Selection for Size and Type: Biometric Measurements of Horse Bones

By measuring horse bones, it is possible to quantify selection and variance in populations (Albarella 2002; Boessneck and von den Driesch 1978). Size changes may be a proxy for selection changes (Albarella, Johnstone, and Vickers 2008; Bartosiewicz and Gál 2013; Van Dijk and Groot 2013; Johnstone 2004; Lyublyanovics 2006; Kyselý and Peške 2016; Murphy et al. 2000). The degree of variance of size within populations may also speak to production goals, the size of a breeding population, or be evidence of exchange between different groups of people and their local horses. A small degree of variance in horse bone measurements may represent a regularization of type (perhaps a commoditization of horses) or a more closed breeding population. The EBA Bell Beaker site of Csepel-Háros is often cited as the definitive evidence for domesticated horses in Europe because of the decreased size and increased variance of the horses when compared to

horses Copper Age settlements of the Eurasian steppes. Increased variance is suggestive of a wider genetic pool and trade in horses between established breeding populations or the selection of more than one type of horse. “The appearance of a significant new variability in horse herds after 2500 BCE could reflect the later development of specialized breeds and functions” (Anthony 2007:204). The horses from Csepel-Háros may be the first clear evidence of the artificial selection of specific traits in horses in Hungary in the EBA.

Biometric Indices: Withers Height and the Slenderness Index

Two biometric measurements of horse bones that estimate the size and conformation of horses are considered here: *withers height* (WH) and the *slenderness index* (SI). Overall size in horses is calculated by measuring the horse from the height at the withers, the point of the horse where the top of the neck meets the back (Figure 5.6). Withers height is expressed in *hands high* (hh) by modern equestrians, where a hand is 4 inches, 10.16 cm with an inch equaling 2.54 cm, and the number following the decimal point indicates inches (e.g. 14.2 hh is 14 hands 2 inches tall, or 147.32 cm). Both measures are generally included in faunal studies that include horse height. For this study, withers height will be shown in centimeters (cm) and hands high (hh).

Estimation of the withers height of horses is determined archaeologically by measuring long bones as the long bones vary with the withers height. Measurements of horse bones in this study follow methods outlined in von den Driesch (1976), the method universally used by zooarchaeologists. Fortunately, earlier faunal studies in Hungary include measurements of the long bones, including the Greatest Length (Gl), which is used to calculate withers height (cf. Bökönyi 1968). Kiesewalter (1888) and Vitt (1952) produced the calculations that zooarchaeologists most

commonly use for determining withers height based on long bone measurements. The Kiesewalter method uses a known multiplier for the different long bones to estimate withers height using the Greatest Lateral Length (GLl) of the long bones. Because this measurement is not always included in all published faunal studies of Bronze Age horse bones, I used the Vitt method in these cases and in my own sample, which is based on the Greatest Length (GL), to calculate the withers height of horses from the earlier published assemblages. In my sample, I checked my Vitt results against results using the Kisewalter method and found the differences negligible. Both methods, provided they are conducted using the appropriate measurements in the first place, provide reliable estimations of withers height, within acceptable error ranges (Johnstone 2004; May 1985).

The slenderness index (SI) based on the measurements of metapodia (metacarpals and metatarsals) and was put forth by Brauner (1916) and Chersky (1891) to determine the degree of slenderness or robusticity of the limbs in a population of horses. It is a measure of the thickness of the bone below the knee and above the ankle (Figure 5.7). Such a measure is thought to indicate type, relatedness, and potential influence of imports on a population. The SI formula is the smallest breadth of the diaphysis (SD) divided by the greatest length (GL) times 100: (SD/GL*100).

Figure 5.6. Arrow Indicates Where Withers Height (WH) is Measured in Horses. Note: Live horses are measured standing square and on level ground.

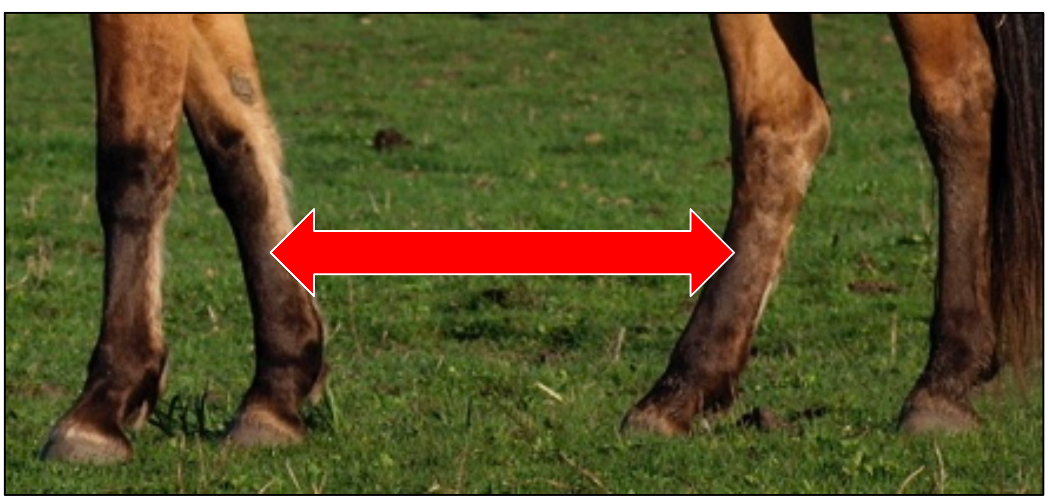

Figure 5.7. Arrow Indicates Where Slenderness Index (SI) is Measured in Horses.

I examined and measured excavated horse bones from faunal assemblages of 7 sites in Hungary to estimate withers height and slenderness indices. I compared these measurements with the published data from 21 additional sites from the Copper Age through the Celtic Period in Hungary and Europe. I used 3m long digital calipers to record measurements in my sample.

Results: Selection for Size and Type in Bronze Age Horses

The results of the biometric analysis of horse bones indicate three important findings: 1) withers height of horses increases consistently through time in Hungary beginning in the EBA; 2) the slenderness indices indicate horse bones become progressively more slender through time; and 3) the variance between horses in a population increases through time as well (Table 5.10; Figures 5.8, 5.9, 5.10, 5.11). The Bronze Age horses in Hungary are substantially larger than horses from elsewhere in Europe at the same time, even larger than all horses of Western Europe in the later Iron Age. Celtic Hungarian horses are substantially smaller, and demonstrate an influx of smaller horses that accompany people from western regions. After mean horse size decreases from Copper Age pre-domestication estimates, mean horse size increases in time by 1” from the EBA to MBA and 2” to the Late MBA Koszider period, or 7.62 cm between the EBA and the Koszider period. The increase in the size of Roman horses in Hungary represents the known influx of foreign stock into the region coupled with the presence of already rather larger horses than elsewhere in Europe. Bökönyi (1968) first discerned that horses in the Iron Age of Hungary were statistically larger and more robust than horses from farther west and north in Europe. He divided these horses into a larger Eastern Group and a smaller Western Group. This trend may have started in the Bronze Age of Hungary. The average size of horses in the MBA is 13 hh, only 2 inches, 4.56 cm, shorter than

the average size of horses throughout the Roman Empire. The horses of the Hungarian Bronze Age were well within the range of the horses used to mount Roman Cavalry (Hyland 1990, 2003).

Period/Site	Mean WH cm	Mean WH hh
CA Botai	139.55	13.2
EBA Hungary	129.56	12.3
MBA Hungary	132.95	13
Late MBA Hungary	137.08	13.2
IA Eastern: Hungary, Slovenia, S. Russia, Bulgaria	136.38	13.1
Roman Hungary Mean	140.75	13.3
Celtic Hungary Mean	123.00	12
BA Italy	128.50	12.2
IA Italy	133.20	13
Roman Italy	137.30	13.2
IA Western: Austria/Germany/Switzerland	124.16	12
IA France/Germany	123.77	12
IA Britain	123.77	12.2
Roman Britain	126.00	13
Roman Empire	137.60	13.2

Table 5.10. Table of Comparative Withers Heights (WH) in Centimeters (cm) and Hands High (hh).

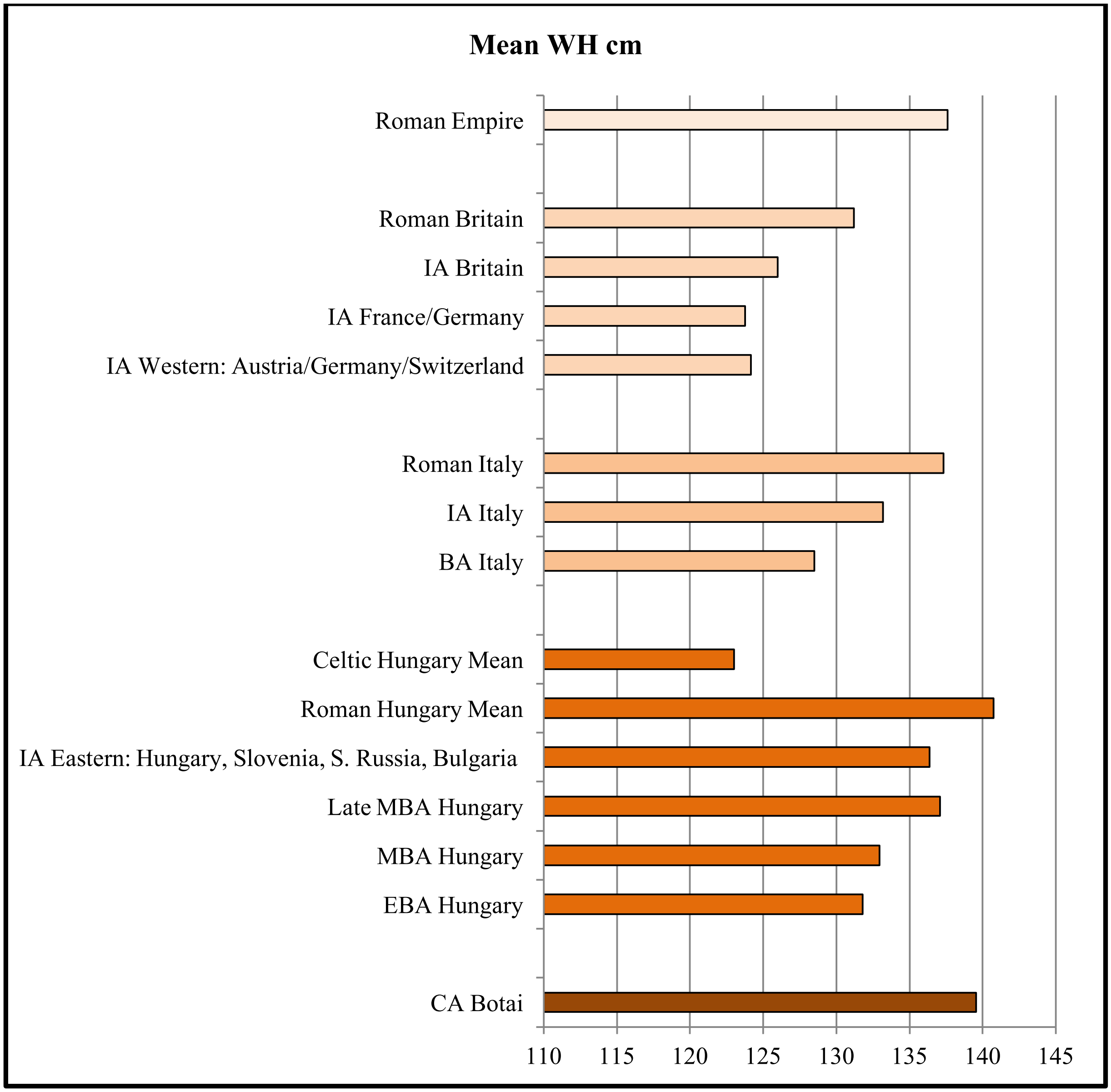

Figure 5.8. Comparative Withers Height (WH) in Horses in Centimeters (cm) from Prehistoric and Early Historic Periods in Hungary and Europe.

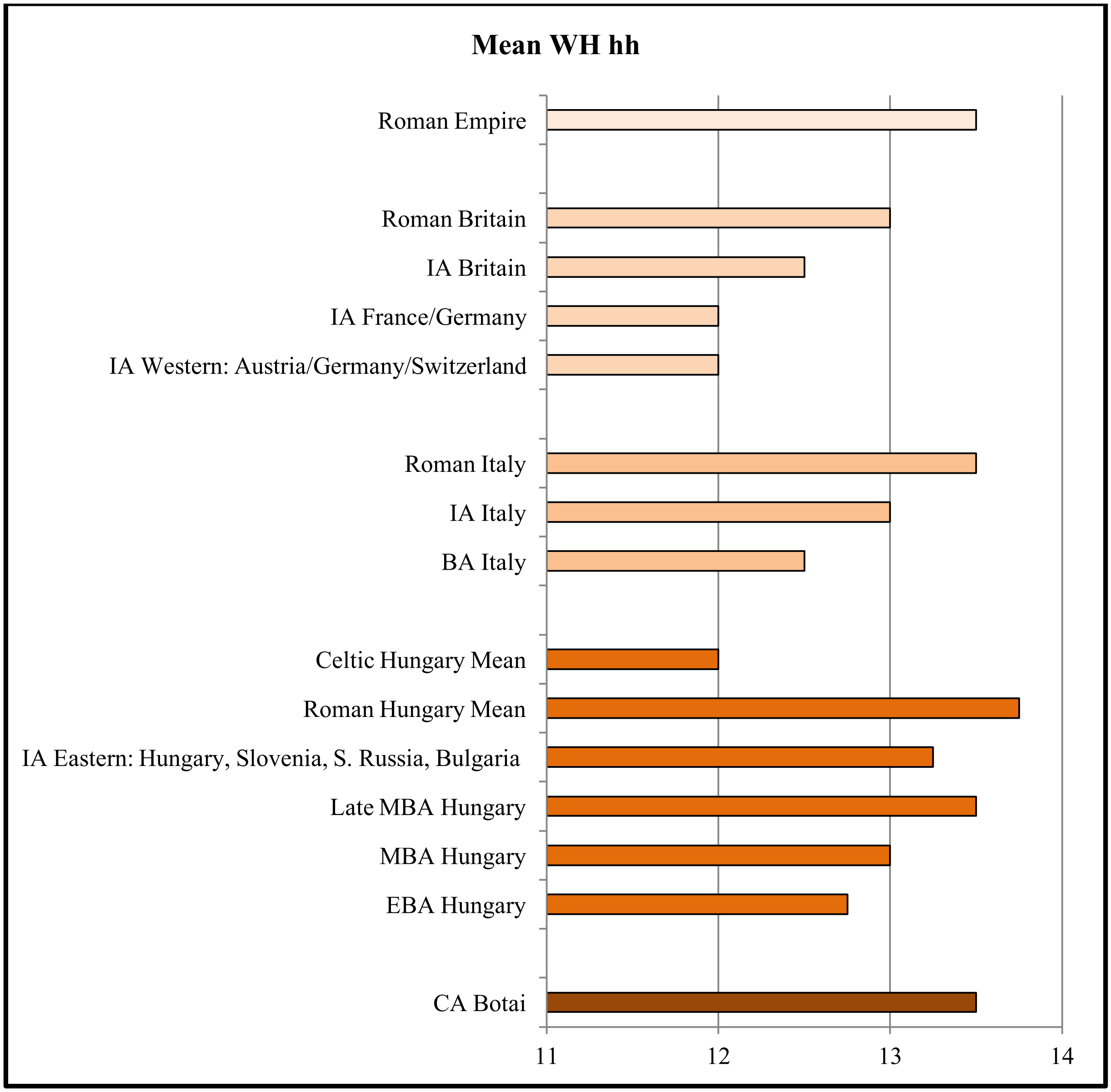

Figure 5.9. Comparative Withers Height (WH) in Horses in Hands High (hh) in Prehistoric and Early Historic Periods in Hungary and Europe.

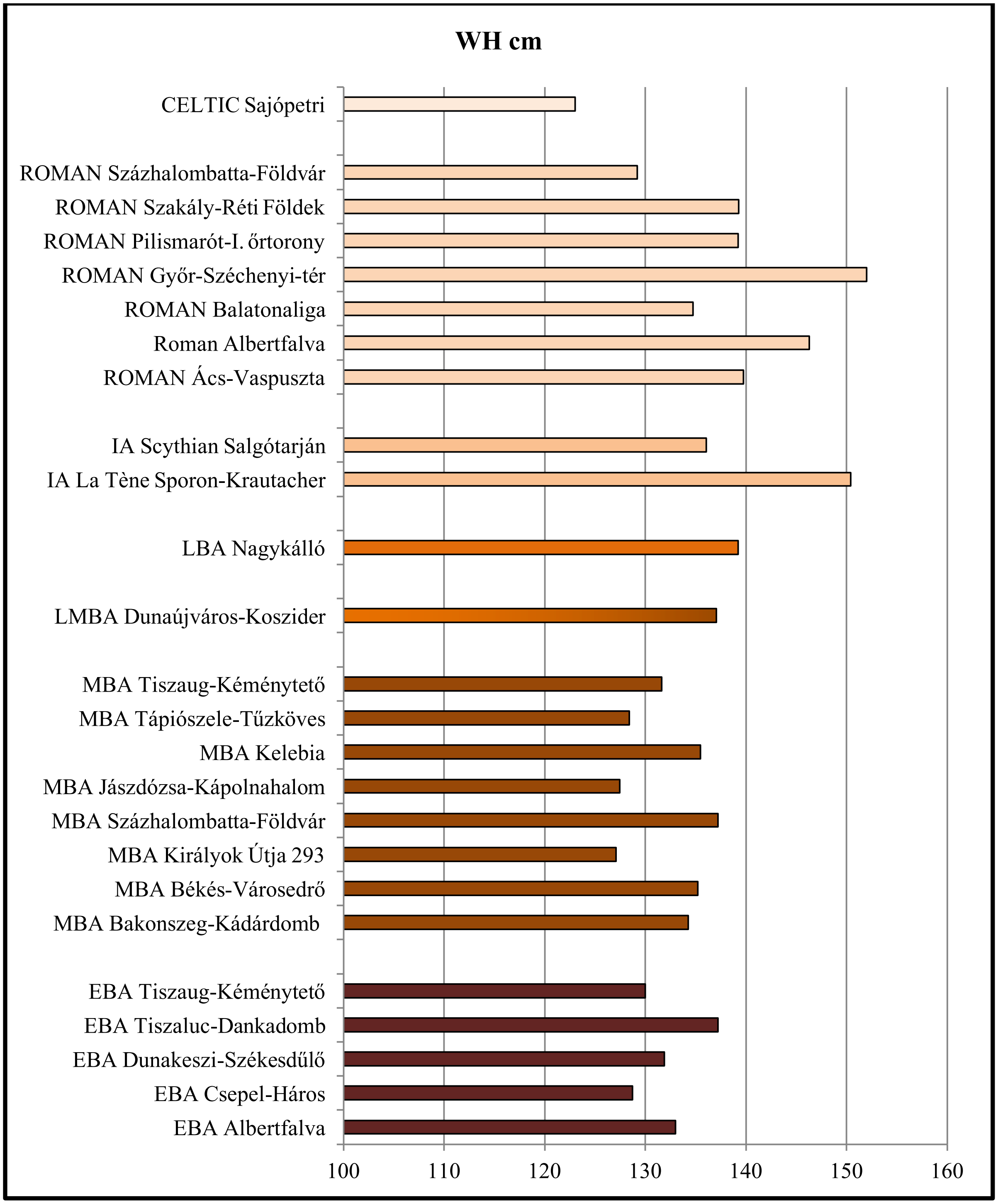

Figure 5.10. Site Means of Withers Heights (WH) in centimeters (cm).

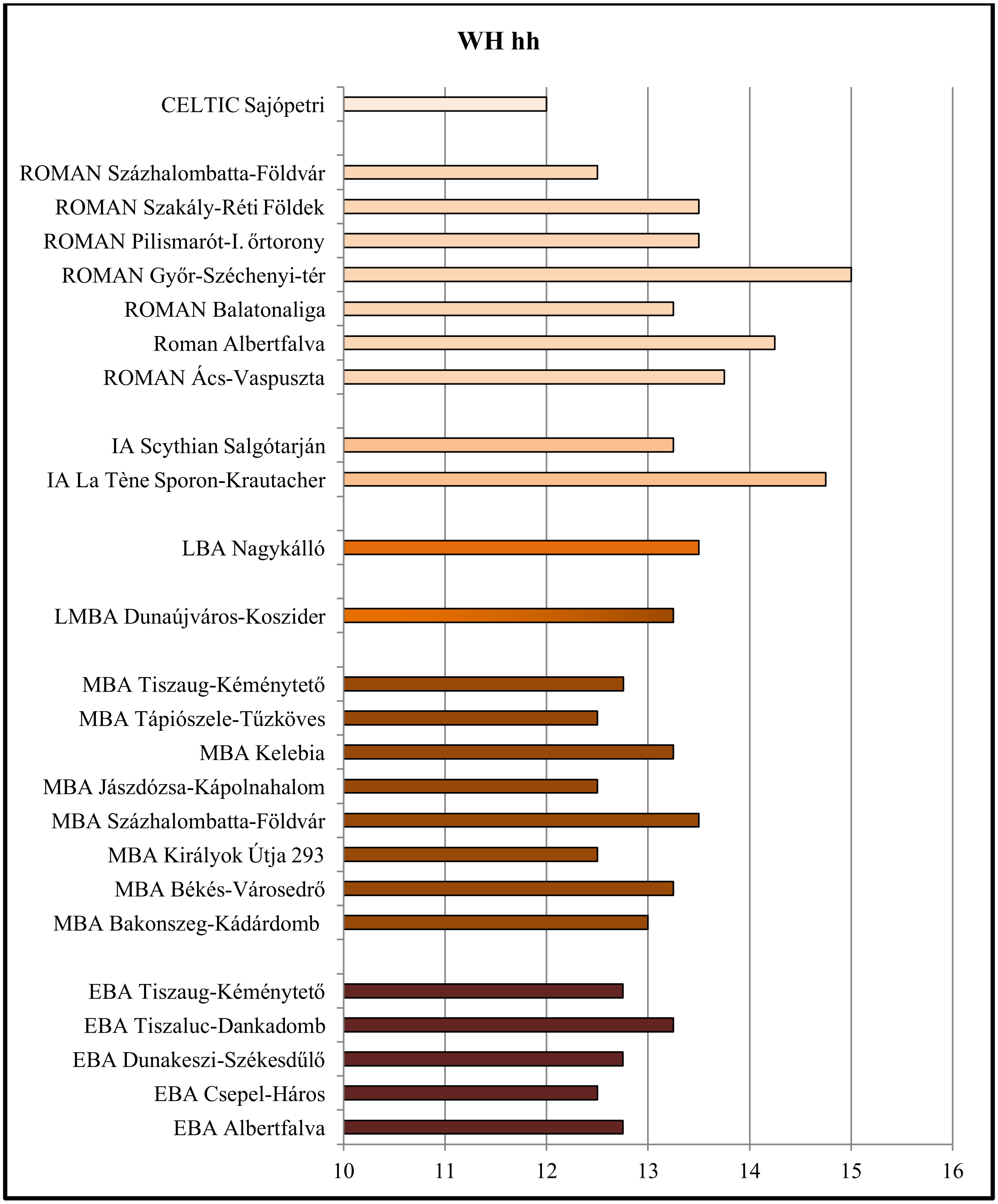

Figure 5.11. Site Means of Withers Heights (WH) in Hands High (hh).

Slenderness increased (SI) from the EBA to the MBA and into later periods (Table 5.11). In the Iron Age, Bökönyi (1968) determined that horses in Hungary and Eastern European sites, were more robust than their western counterparts, and suggested that a more robust horse was preferred. Genetic data indicates that Iron Age Pazyryk horses of Siberia and Kazakhstan were selected to be similarly robust (Librado et al. 2017). The Iron Age data likely reflect the documented influx of Scythian peoples and their preferentially more robust horses into Hungary. The trend is still for a slender legged horse through time, a trait likely selected for by horse breeders beginning in the MBA. All modern horses plot from slender to very slender (Johnstone 2004).

Period	SI	Brauner	Chersky
EBA	16.67	Slightly Massive	Medium legged
MBA	15.55	Medium Slender	Medium Legged
IA Eastern	15.19	Slightly Slender	Medium Legged
IA Western	14.513	Slender	Slender
Roman	13.73	Slender	Slender

Table 5.11. Slenderness Indices (SI) of Horses from Metacarpals Through Time in Hungary.

The increase in the variance of horses' sizes (Table 5.12) probably reflects two things: 1) selection for different types of using horses, and 2) exchange in horses from different regions, as also demonstrated by the stable isotope results above.

Hungarian Samples	EBA	MBA	Roman
WH Mean in cm	131.80	132.95	140.75
Variance	16.25	31.04	68.55
STD DEV	4.03	5.57	8.28

Table 5.12. Variance of Wither's Heights (WH) of Horses Through Time in Hungary.

Often wrongly assumed in the past to be too small to ride, horses from the beginning of domestication were sufficiently large to carry grown adults. There is a misinterpretation that larger is always better in horses, or that small horses couldn't carry fully grown adults. In fact, horses between 13 and 15 hh were often preferred in cavalry over larger horses because of their hardiness and ability to subsist on less feed (Sidnell 2007). There are diminishing returns for height in terms of athletic performance in horses, and smaller horses are preferred for modern equestrian disciplines that require extreme agility and endurance, such as polo, cattle cutting, and endurance riding. Larger size generally increases speed but it begets more frequent skeletal disorders and breakdowns. Figure 5.12 shows the average withers heights of MBA horses in this study compared with Bronze Age people. Average height in the Bronze Age of Hungary was 168.31 cm (just over 5 ft 6 in) for a man, and 157.2 cm (just under 5 ft 2 in) for a woman (Ubelaker and Pap 1996).

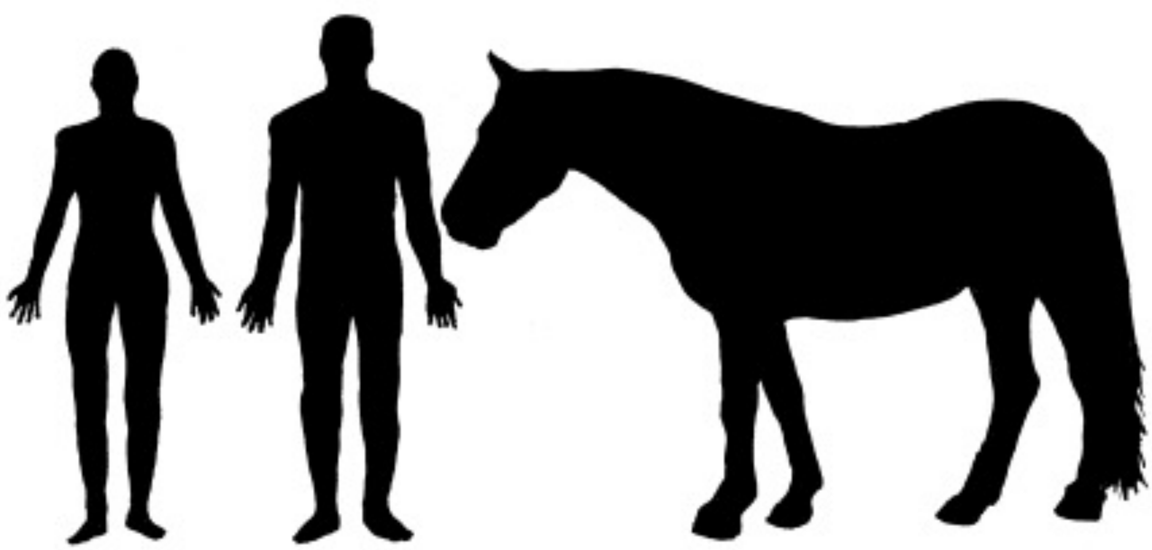

Figure 5.12. Visual Comparison of Human and Horse Height (hh). Horse is MBA average 132.95 cm or 13 hh (52"). Woman (L) is 157.2 cm or 5'2" (62"). Man (R) is 168.31 cm or 5'6" (66").

While horses grew taller during the Bronze Age of Hungary, human height for men remained relatively stagnant while women grew taller. Ubelaker et al. (2006) report mean height in Neolithic Hungary for women was 155.0 cm, and men 168.1 cm. In the Copper Age of Hungary, Ubelaker and Pap (Ubelaker and Pap 2009) show mean height for women as 156.7 cm, and men as 168.2 cm. The average height of women increased 1.7 cm from the Neolithic to the Copper Age, and 0.5 cm from the Copper Age to the Bronze Age, while men only grew taller by 0.1 cm from the Neolithic to the Copper Age and 0.11 from the Copper to the Bronze Age. Over time, from the Neolithic to the Bronze Age, women grew significantly taller compared to men, gaining 2.2 cm compared to 0.31 cm. Horses gain 7.52 cm in height from the EBA to the LBA.

Summary of Horse Production and Use Implications in Bronze Age Hungary

Production for primary (meat and carcass) and secondary (milk, riding, and draught) use may be assumed for the EBA by the incredible concentration and numbers of horses at Bell Beaker-Csepel Group settlements at the Danube Bend and the subsequent spatial dispersion of horses into MBA settlements. During the MBA, small-scale production for primarily secondary use was evident by the relative abundance of horses in NISP %, demonstrating sufficient numbers of horses, with mortality profiles that are indicative of a breeding and transport population. Surplus production for use and exchange was likely in the EBA, given the high ratio of people to horses. Small-scale surplus production in horses was possible in the MBA given the appreciable numbers of horses with full breeding populations and estimates of the ratios of people to horses which show the possibility of surplus animals compared to numbers needed for use. Some evidence for

exchange was given by the mortuary profiles that highlight settlements like Százhalombatta-Földvár may have exported some prime aged animals, while others appear to have been only importing animals, such as the Gyularvarsánd tells in the Berettyó Valley. Exchange in horses during the Bronze Age of Hungary is substantiated by the $^{87}Sr/^{86}Sr$ isotope analysis. Some sites, like the Vatya Százhalombatta-Földvár obtained horses from a great distance outside of the Carpathian Basin while also breeding horses locally. The Berettyó Valley settlements were apparently importing all their horses as mature animals for use. The isotope data gives tantalizing clues that horses and bits, metal ores, and their exchange may be related during the MBA.

Selection for specifically larger sized horses was evident in increased withers height (WH) through the course of the Bronze Age in Hungary. Horses were larger in the Bronze Age of Hungary than elsewhere in Europe, a trend that remains in place through the Iron Age and Roman Period. The increase in variance of the size of horses from the EBA through the Iron Age may reflect that people selected a wider variety of traits in horses for particular uses. The decrease in the robusticity (SI) of lower leg bones may indicate a preference for more refined types of horse through time or increased exchange with other regions as evident from the isotope data. This stands in contrast to selection for stockier legged horses on the steppes of Eurasia.

However, intensification in horse breeding was not apparent through the course of the Bronze Age in Hungary, as no sites show an increase in production through time, save very modest upticks in horse numbers during the Koszider Period at Százhalombatta-Földvár. What this very small change in relative horse abundance is not yet clear. The presence of a modest, but appreciable number of horses with full-breeding population, missing some prime aged animals, having animals imported in from a distance, with an increase in withers height and the age-at-death from the MBA

to the LBA, may show that the Százhalombatta-Földvár polity had a small-scale but consistent household/kin centric model of horse breeding, training, use, and exchange. This stands in contrast to the exploitation observed at the likely center of intensive horse breeding in the Southeast of the Carpathian Basin just outside Hungary at the Romanian Maros/Perjámos tell settlement of Pecica-*Şanțul Mare*. Here there was a pretty obvious intensification in production and ritual use during the MBA prior to a peak in metallurgical production and settlement expansion.

In sum, the horse breeding of MBA of Hungary may be generally characterized by small-scale production for use and some extra-regional exchange. Selective breeding for types of horses was possible. Horse breeding and use was not homogenous throughout the MBA cultures of Hungary. Rather, the heterogeneous character of horse husbandry mirrors animal production strategies and the scale of craft production and trade evident at the MBA tells. Isotope data and the case of Romanian Pecica-*Şanțul Mare* show some possible relationships between horses and metallurgy, but this is very tentative. Missing so far are obvious connections of elite control of horse breeding, exchange, and use in Bronze Age Hungary.

CHAPTER 6

Pieces and Bits:
Thinking About and Using Horses in the Hungarian Bronze Age

In this chapter, I further investigate two topics that are central to understanding the broader question of how the transformations of the relationships between people and horses impacted the Hungarian Bronze Age: 1) how people thought of horses, and 2) how people used horses. The hypothesized increase of the importance of horses, and the appearance novel equestrian technologies, like bridle bits and chariots, deeply implicate horses in the grand narratives of a Pan-European charioteering warrior elite developing in the Bronze Age. These topics are essential for exploring both the validity of political economy model and in evaluating if there were centralized polities with expanding political economies in Hungary that used horses to attain political aspirations and mark social difference.

With further zooarchaeological analysis of body part representation, cut marks, depositional patterns, and horse bone tools, in the first part of this chapter, I demonstrate that people thought about horses differently than the other domesticates based on how people treated horses when and after they died. This changed from the EBA through the MBA, shifting again in the terminal LBA. The increased cultural significance of horses was related to the intensification in the use of horses to ride first and then fight from later. By the terminal LBA and into the IA, this importance shifts again to one of increased closeness and reliance as horses began regularly appearing in human burials. This is coincident with an explosion of artifacts decorated with horses, absent from previous periods.

In the second half of this chapter, I illustrate that the earliest material culture related to horses, the cheekpieces for bridle bits, and were an indigenous, autochthonous development unique

to Hungary associated with riding. I establish that chariotry was not of any consequence in the Hungarian Bronze Age when the material evidence, décor, and chronologies formerly used to establish its intrusion are incorrect. Moreover, this data rather substantiates that there was no such 'chariot package' which tied horses to warriors and weapons and ostentatious burials in the Hungarian Bronze Age.

Thinking About Horses

From the earliest documented domestication sites in the Copper Age, such as Botai, domesticated horses were exploited for primary (meat and carcass) uses, and their secondary use as mounts to herd other animals and for milk (Anthony 2007; Anthony and Brown 2011; Anthony et al. 2006; Gaunitz et al. 2018; Outram et al. 2009). Probably due to the migrations of later peoples and their horses related to early horse domesticators, the Yamnaya (Goldberg et al. 2017; Haak et al. 2015), this pattern of usage likely continued into the EBA at the Bell Beaker-Csepel Group settlements in Hungary near Budapest (Bökönyi 1978; Endrődi and Reményi 2016a; Lyublyanovics 2006). As at the Copper Age settlements in the Pontic Caspian steppes, there were incredibly high numbers of horses compared to the other domesticated taxa, culling rates show that a large number of younger individuals were slaughtered for meat, but a number of horses survive into old age which also indicates the likelihood of transport based usage.

The previous chapters and previous work has established that this pattern was altered into the MBA in Hungary, where horses comprise a relatively low number of animals compared to other domesticated taxa, they are dispersed more widely at many of the major tells in the region, the age classes show that many more horses survived into adulthood and old age, and depositional

practices suggest that horses begin appearing in new contexts (Bökönyi 1988; Choyke 2000; Choyke and Bartosiewicz 1999, 2009; Choyke et al. 2004; Nicodemus 2014; Vretemark and Sten 2005; Vretemark 2010). All of this suggests that human and horse relationships were transformed in the Hungarian Bronze Age. Four areas of evidence were examined to determine indications of the cultural significance of horses to peoples of the Hungarian Bronze Age and to confirm if those ideas shifted through time: 1) body part representation, 2) cut marks, 3) deposition patterns, and 4) tools made of horse bones.

Body Part Representation

The quantification of the body part distributions of horses, that is identifying the number of each bone of the skeleton present for the overall site, from different time periods and different contexts, affords information regarding "taphonomy; butchering; transport; food preparation; disposal habits; activity areas; site function; economic institutions; and social organization" (Reitz and Wing 2008:202). This quantification can also delimit ritual or specialized use, such as purposeful burial, feasting, or the utilization of hides or bones for tools. Two related metrics are of use here, 1) the frequency of each bone (element) of the horse's skeleton recovered from archaeological contexts, and 2) the economic utility of carcass products represented by each bone, including meat, marrow, bone, sinew, and hide.

Zooarchaeologists have long made use of so-called utility indices after Binford (1978) argued that after killing large game, hunters would leave bones from low utility elements at kill sites while high utility elements would be transported back to camps, and created a Modified General Utility Index (MGUI) to relate these choices to the economic utility of the carcass.

Uerpmann (1973, 1982) developed a 3-part quantification of body part representation that took into account the meat quality, divided between (A) low, (B) medium, and (C) high, which many European zooarchaeologists continue to use. Metcalfe and Jones (1988) simplified and improved Binford's MGUI into the Food Utility Index (FUI). However, none of these measures do a sufficient job of understanding the skeletal part abundance and utility of horse carcass products because they were developed variously from wild hunted animals and other domesticated livestock. The utility of the horse carcass is actually quite unique, even compared to their close kin like zebra.

Outram and Rowley-Conwy (1998) devised a Meat Utility Index (MUI) and Marrow Index (MI) specifically for horses, and developed a Standardized Food Utility Index (SFUI) thereafter. Outram (2006) further clarified the effects of the Bone Mineral Density (BMD) of each skeletal elements and the absolute weight of the butchered parts of a horse to address issues of taphonomic impacts of the relative frequencies of each horse bone from archaeological sites and the decisions people made to transport the bone with meat back to a settlement or dress the meat in the field (among hunters though). The significant weight of the carcass of a horse, even after it has been divided into head, thorax, forelimbs, and hindlimbs, makes it difficult to transport on foot without the aid of pack animals. The bone density data help to understand that taphonomic processes should affect all similarly sized animal's skeletons equally. In simpler terms, when it comes to horses, if bones from all regions of the horse are generally present, they were killed near or at where they have been found. If they were processed for carcass products like the other domesticated animals, each domesticated species should show relatively the same patterns in terms of skeletal part abundance.

If slaughter and butchering occurred in a settlement, generally all skeletal elements should be recovered (Gifford-Gonzalez et al. 1980). If they are being hunted, or if domesticated horses are slaughtered and field dressed off-site, but consumed within a settlement, it is likely that the bones from the meatiest elements would be found at the settlement. Outram and Rowley-Conwy (1998) quantified the meatiest elements as the vertebrae and ribs, the pelvis, and the upper hind limb (the femur). The upper forelimb (the humerus) has notably less meat than the hind limb, while the lower limb bones have no meat. They also noted that the marrow yields from horse bones are relatively low when compared to similarly sized animals, such as cattle, and the upper limbs also yield the most marrow. The desire to utilize the carcass for tools and hides must also be considered when looking at body part representation through skeletal element abundance.

In the Upper Paleolithic when people were clearly hunting and consuming wild horses, entire and processed horse skeletons were recovered in situ at kill sites such as Solutré in France (Olsen 1989). At Copper Age sites where people were most certainly consuming domesticated horses, such as Botai, all skeletal elements should be recovered if slaughter and carcass processing occurred on site. At Botai, this is indeed the case, as controlled slaughter probably occurred at the settlement (Gaunitz et al. 2018). All skeletal elements were represented, there were articulated series of vertebrae were found intact, and slaughter was undertaken via a blow to the skull, called *poleaxing* (Benecke and von den Driesch 2003; Olsen 2003, 2006; Olsen et al. 2006; Outram et al. 2009).

For this study, I compared the body part representation of horses from published reports where such raw data is included: EBA Bell Beaker Albertfalva (Lyublyanovics 2016), EBA Nagyrév/MBA Hatvan Tiszaug-Kéménytető (Choyke and Bartosiewicz 2000), MBA Pecica-

Şanțul Mare (Nicodemus 2014), and Roman Szákál-Réti Földek (Vörös 1982); and the sites from my own analysis including EBA Dunakeszi-Szekésdűlő, MBA Kiralyók Útja 293, MBA Berettyó Valley tells combined, and MBA/LBA Százhalombatta-Földvár. A further analysis of Százhalombatta-Földvár is undertaken because of the careful way it was excavated and because of my access to the analysis of entire faunal assemblage thoroughly documented by Choyke (2000) and Vretemark and Sten (2005). I first consider the body part representation by element and then general skeletal region, (Head, Trunk, Upper Limbs, and Lower Limbs) across all the sites which will show if any elements are regularly under- or overrepresented (Figure 6.1).

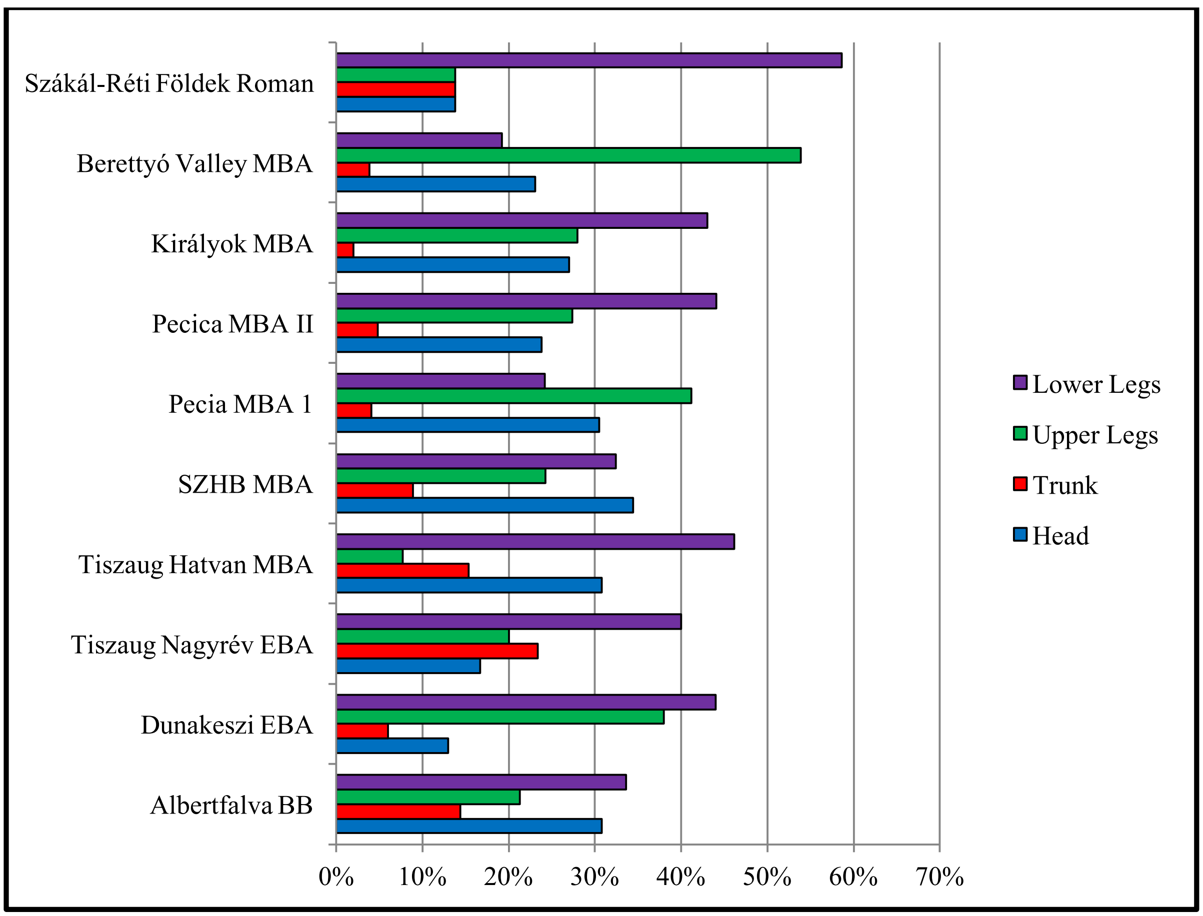

Figure 6.1. Body Part Representation by Site.

The overall pattern of body part representation throughout the Carpathian Basin Bronze Age shows a generally low representation of bones from the trunk (spine, ribs, and pelvis) and upper legs and a high representation the distal limbs and head. With horses, the trunk and upper legs are high utility and the head and lower legs are of lower utility. Notable exceptions to the body part representation skewed towards distal limbs and heads are EBA Dunakeszi-Szekésdűlő, MBA I Pecica, and the Berretyó Valley tells which have a comparatively good representation of high utility, meaty upper limb elements present. Besides a lower frequency of upper limb bones, the trunk elements are quite poorly represented and this must be explained.

Taphonomic processes, such as density-mediated attrition, anthropogenic processes, site preservation, and recovery bias can certainly affect this pattern, and such issues are often cited as a reason for the pattern of low utility patterns in horse body part representation. However, Outram (2006:52) cautions that differential taphonomy cannot explain the anomalous representation of horse remains when compared to similarly sized taxa and neither can density mediated attrition because "the density of the pelvis acetabulum and scapula epiphysis is every bit as high as the ephipyses of the distal limbs, and much higher than the density of the upper limb bone ends. There is no reason why these elements should be poorly represented". This is especially true when preservation bias is not a factor and other species of similar size have the elements that are missing in horses present, such as at Százhalombatta-Földvár and Kiralyók Útja 293.

Nicodemus (2014) at Pecia and Lyublyanovics (2016) at Albertfalva explain low utility pattern in horse element abundance they observe is due to density mediated attrition, taphonomic processes, and difficulty identifying ribs and vertebrae to taxon (especially when fragmented) that render the elements from the trunk relatively scarce. However, all skeletal elements were present

at these sites, including the trunk and upper limbs. There is no doubt different forms of preservation bias heavily affected the recovery of faunal remains from EBA Bell-Beaker Csepel-Group Albertfalva, as the bones were heavily calcined and fragmented for marrow extraction (Lyublyanovics 2016:204). Similarly, at Pecica, the remains were also heavily calcined and friable, due to the intense burning of the settlement, so they were also highly fragmented (Nicodemus 2014:226–227). Both authors find that horses were generally slaughtered and processed similarly to the other domesticated species, especially like cattle. Nicodemus (ibid:233-235) suggests that slaughter and primary butchering took place outside of the main settlement, which also affects the body part representation. The Florescent Period (MBA I:1900-1720 BC) at Pecica also has unique features comprised of an overrepresentation of meaty upper limb bones of prime aged mares placed in what Nicodemus terms *bone-pile*, a deposit that is perhaps evidence of feasting and likely continued exploitation of horses for their meat.

I next used a simplified version of Outram and Rowley-Conwy's (1998:845) SFUI for horses, divided as higher utility vs. lower utility, as after Nicodemus (2014:200–201). Nicodemus classified bones using Outam and Rowley-Conwy's SFUI as very high (SFUI 100-45): cervical vertebrae, thoracic vertebrae, ribs, sternum, pelvis, sacrum, femur, and patella; high (SFUI 25-15): cranium, lumbar vertebrae, scapula, humerus, tibia and fibula; medium (SFUI 10-7) radius, ulna, astragalus, calcaneus, tarsals; and low/very low (SFUI <5): carpals, metacarpals, metatarsals, phalanges, and sesamoids. She subsequently lumped very high, high, and medium into a higher utility category and low and very low into the lower utility category.

However, quite different results can be seen when medium is put into the lower utility category (Figure 6.2). So the interpretation into how heavily people were utilizing horses for

consumption or carcass processing by proxy of higher utility elements rests somewhat on if the medium category of elements are lumped with higher utility or lower utility categories (after Outram and Rowley-Conwy 1998:845, Table 6). This categorical judgment call could be solved if there was a clear way to simply numerically quantify the SFUI, a useful project for the future. Outram and Rowley-Conwy did not divide their SFUI in this way, and I do it for comparative purposes here to follow Nicodemus.

From my experience butchering a horse, I tend to be more conservative and follow Outram and Rowley-Conwy (1998:841) when they state that, "the radius/ulna and tibia carry very little meat". The astragalus, calcaneus, and tarsals have none at all. Marrow is similarly depressed towards the distal limbs, although tools made from radii and metapodia and the desire for other carcass products such as hides and sinews must be considered in this pattern. Thus, the second figure of SFUI with medium lumped into lower utility (Figure 6.3) fits better with Outram and Rowley-Conwy's intention when they devised the SFUI to reflect the utility of the skeletal elements as utilized for meat and marrow. The lower utility pattern also is more suggestive to me of the likely way the Bronze Age peoples of the Carpathian Basin exploited horse carcasses: with some intensive use of higher utility upper limb and trunk elements at some sites through time, but an overall pattern of more usage of lower utility distal elements or a pattern of usage and deposition that leaves these elements to be recovered at the settlement. When the medium utility elements are lumped to the higher utility category, it may overestimate the intensity of horse carcass utilization.

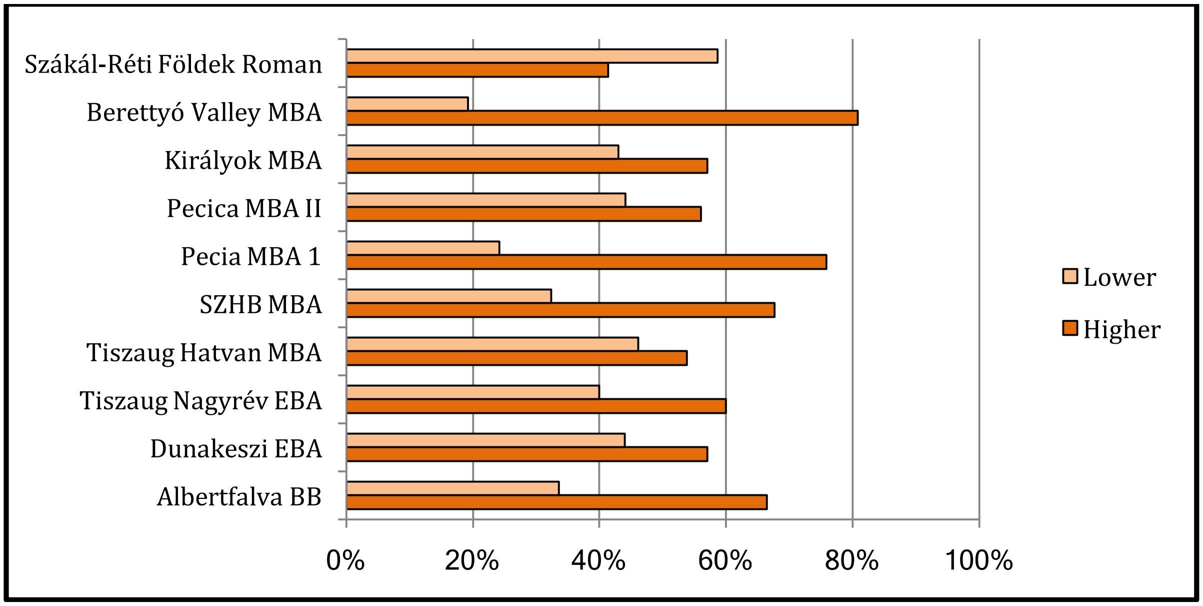

Figure 6.2. Differences Between Lower and Higher Utility Elements Compared Between Sites, Medium SFUI Elements Considered Higher Utility (after Nicodemus 2014:200–201).

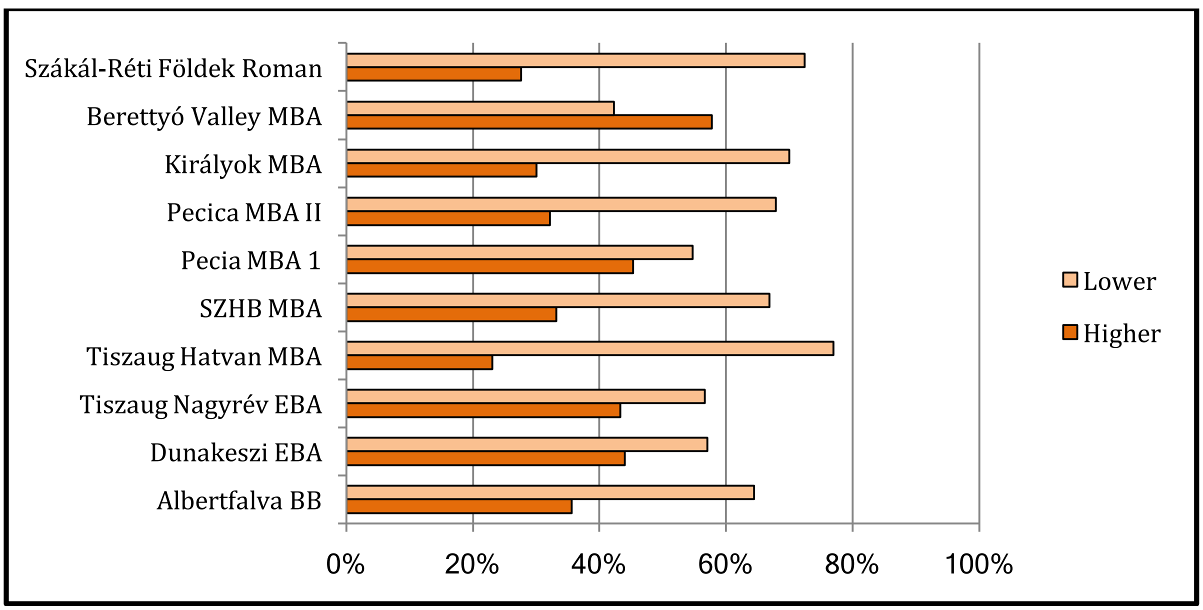

Figure 6.3. Differences Between Lower and Higher Utility Elements Compared Between Sites, Medium SFUI Elements Considered Lower Utility.

Admittedly small sample sizes make anything other than general comparisons possible for and EBA Dunakeszi-Szekésdűlő (Csippán 2007), MBA Hatvan Tiszaug-Kéménytető (Choyke and Bartosiewicz 2000), MBA Berettyó Valley Tells (Bökönyi 1988b), and Roman Szákál-Réti Földek (Vörös 1982). The availability of published data and sites I had access to mean that only EBA BB Albertfalva, Százhalombatta-Földvár, and Királyok Útja 293 could be used to further compare body part representation by skeletal element (Figure 6.4). Even though taphonomically and anthropogenically affected, EBA BB Albertfalva has all skeletal elements represented, even if they are at lower percentages. This suggests that primary slaughter and butchering occurred on the settlement. MBA Százhalombatta-Földvár and MBA Királyok Útja 293 are greatly overrepresented by low utility distal skeletal elements and loose teeth.

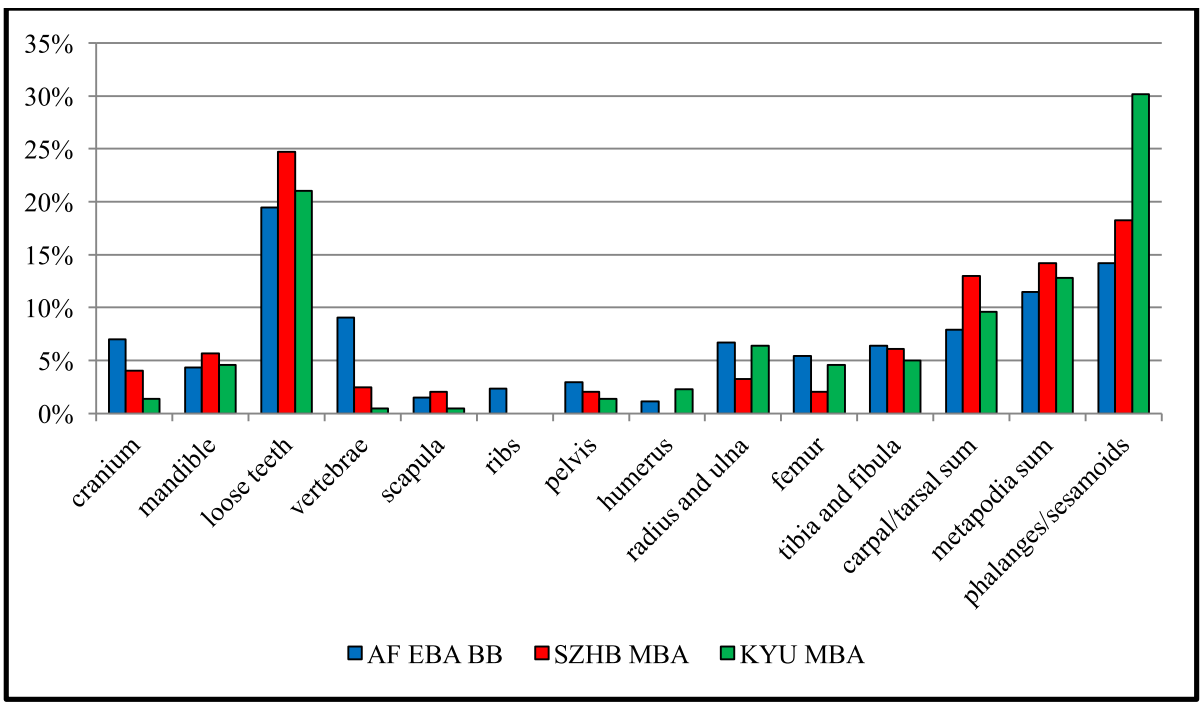

Figure 6.4. Horse Body Part Representation by Specific Skeletal Element at Three Hungarian Bronze Age Settlements.

The horses of Százhalombatta-Földvár are overrepresented by skull, teeth, and lower limb bones (carpals, tarsals, and phalanx). There is a near absence of rib, vertebrae, scapula, and pelvic bone and a complete absence of humerii. While Choyke (2000) found the high percentage of lower limb bones, skull fragments, and teeth of horses and cattle at Százhalombatta to likely be evidence of preservation and identification bias in the earlier collection she analyzed, Vretemark and Sten (2005:Figure 4) did not find a similar issue with preservation and identification of bone they analyzed from the 1989-1991, and the 1999-2005 excavations (Figure 6.5). Vretemark and Sten were able to recognize cattle and horse vertebrae and ribs from the site. Moreover, in the case of cattle, ribs and vertebrae were the most numerous bones of this taxa at the site.

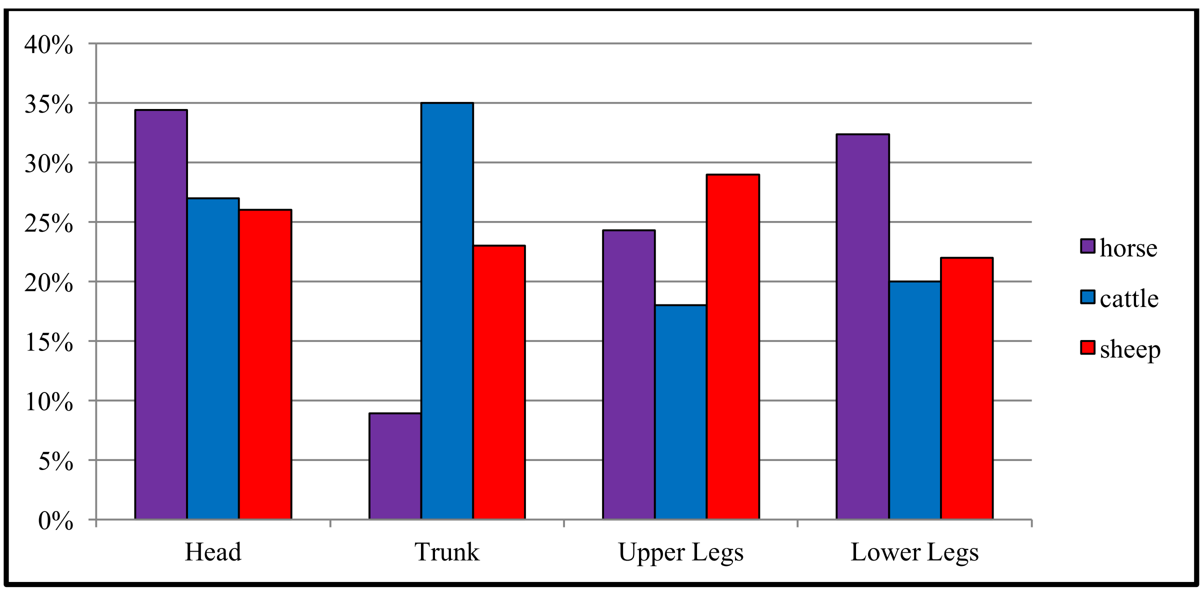

Figure 6.5. Body Part Representation Compared Between Horse, Cattle, and Ovacaprids from Százhalombatta-Földvár.

Unlike EBA Bell Beaker Albertfalva and MBA Pecica, vertebrae, ribs, and pelvis in the faunal sample do not seem to be particularly susceptible to preservation bias. In addition, the lower limb bones of cattle (carpals/metacarpals, tarsals/metatarsals, and phalanx) were the least

numerically significant at the site in this analysis. Unlike the other domesticated animals, at Százhalombatta-Földvár, the relative abundance of skeletal elements suggests horses were not butchered on site. Rather, I would suggest they were probably processed where they died, and desired elements were transported to the settlement for further carcass products. There is good evidence the other animals were brought into the settlement on the hoof and slaughtered there (Vretemark 2010:169).

The careful excavation and subsequent faunal analyses of Százhalombatta-Földvár by Choyke (2000), Choyke et al. (2004), Vretemark and Sten (2005), and Vretemark (2010) offers additional insights into how people thought of horses. The evidence at Százhalombatta-Földvár presents horses as being treated differently in death and carcass processing than the other domesticates. This suggests that they were both considered and used differently by the peoples there than cattle and ovacaprids, and also were exploited differently from EBA BB Albertfalva and MBA Pecica where all skeletal elements were represented.

Even though the sample sizes are small from EBA Nagyrév/MBA Hatvan Tiszaug-Kéménytető, EBA Dunakeszi-Szekésdűlő, and the MBA Berettyó Valley tells and must be treated with caution at this point, some indications of the differential use of horses between the EBA sites, the MBA Vatya sites, and the Eastern MBA Gulyarvarsánd and Southeastern Maros Tell as expressed by the body part representation follow the impression of a generally higher utilization of lower utility elements. The EBA sites of Albertfalva and Dunakeszi-Szekésdűlő seem to have probably processed horses on or very near the settlements and utilized more meaty elements. This is similar to the MBA Berettyó Valley tells. This diachronic and regional patterning is suggestive of two things: 1) in the EBA, when horses first arrive in significant numbers in Hungary, they are

being extensively utilized for both carcass and transportation. In the MBA, as some sites have relatively fewer horses, the utilization shifts to primarily utilizing horses for transport and their carcasses are less utilized for meat (in agreement with Bökönyi 1988b; Choyke 1984, 2005; Choyke et al. 2004; Vretemark and Sten 2005; Vretemark 2010); and 2) the eastern and southeastern tells may have more continued contacts with the steppes, and potentially have a further steppe character to a balanced primary and secondary use of horses. The isotopic data (Chapter 5) illustrated that the eastern tells were getting their horses (and likely equestrians) from the fringes of or outside of the Carpathian Basin. The Romanian MBA tell at Pecica has an early and unique emphasis on horse husbandry, unlike contemporaneous tells in Hungary. This potentially reiterates the diachronic and regional heterogeneity in horse usage in the Bronze Age and perhaps highlights linkages to other equestrian peoples farther east from the east and southeast of the Carpathian Basin, based on the general ways they exploited horses.

Cut Marks

"Within a zooarchaeological context cut mark analysis is invariably employed to explore economics, subsistence and/or procurement of meat, despite the fact that it can tell us a great deal about the perceptions and cultural contexts of animals" (Seetah 2007:75). Cut marks are also illustrative of human activity patterns and tool use. The presence or absence of cut marks are invariably used in a one-to-one correlation to determine if people ate certain animals or not, but this should not always be assumed was the intended end use of the carcass. Cut marks also result from carcass use for tools, hides, or other valuable resources. Cut marks and their analysis should always be contextualized within other evidence for animal exploitation.

Cut marks from butchering are actually somewhat poorly represented on Bronze Age horses in Hungary, as is often the case with all domesticated animals of the period. Percentages are shown in Figure 6.6. In sites I analyzed, I did not perform a detailed or microscopical analysis, but recorded the presence or absence of cut marks, the location on the bone, and my general impression of the type of cut marks. "Importantly, there are few traces of butchery marks on bones during the Bronze Age", attributed at Albertfalva (0.76% on horses, 0.51% on cattle) and Pecica (<1%) to taphonomic processes and the nature of bronze tools (Lyublyanovics 2016:204; Nicodemus 2014:243). My impression from the better preserved MBA Vatya sites is that horses were dismembered with strong hack marks on distal elements and through their hocks and knees to quickly break down the carcass as one would do in the field before transporting the desired elements back to the settlement (Figures 6.7 and 6.8).

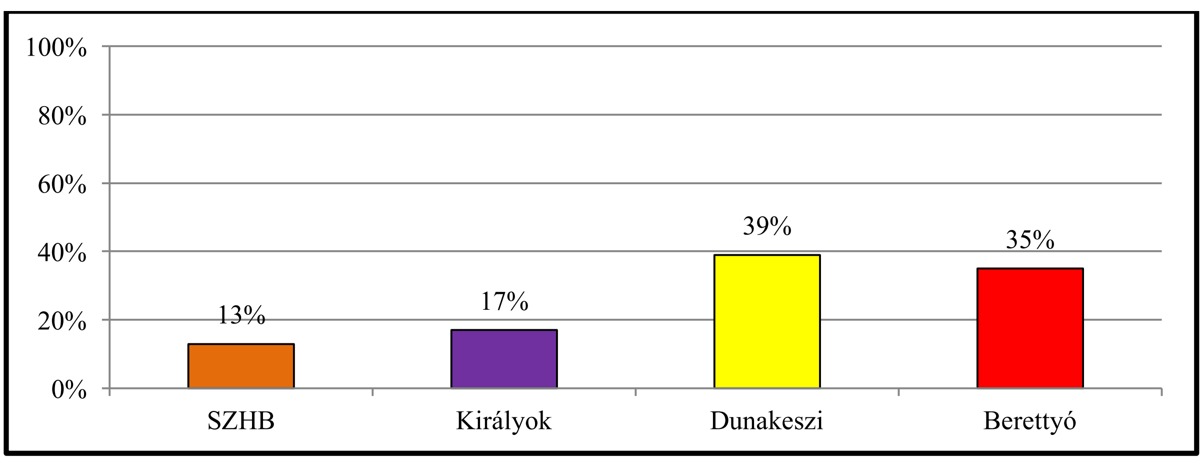

Figure 6.6. Percentage of Horse Bones with Cutmarks at Bronze Age Hungarian Sites.

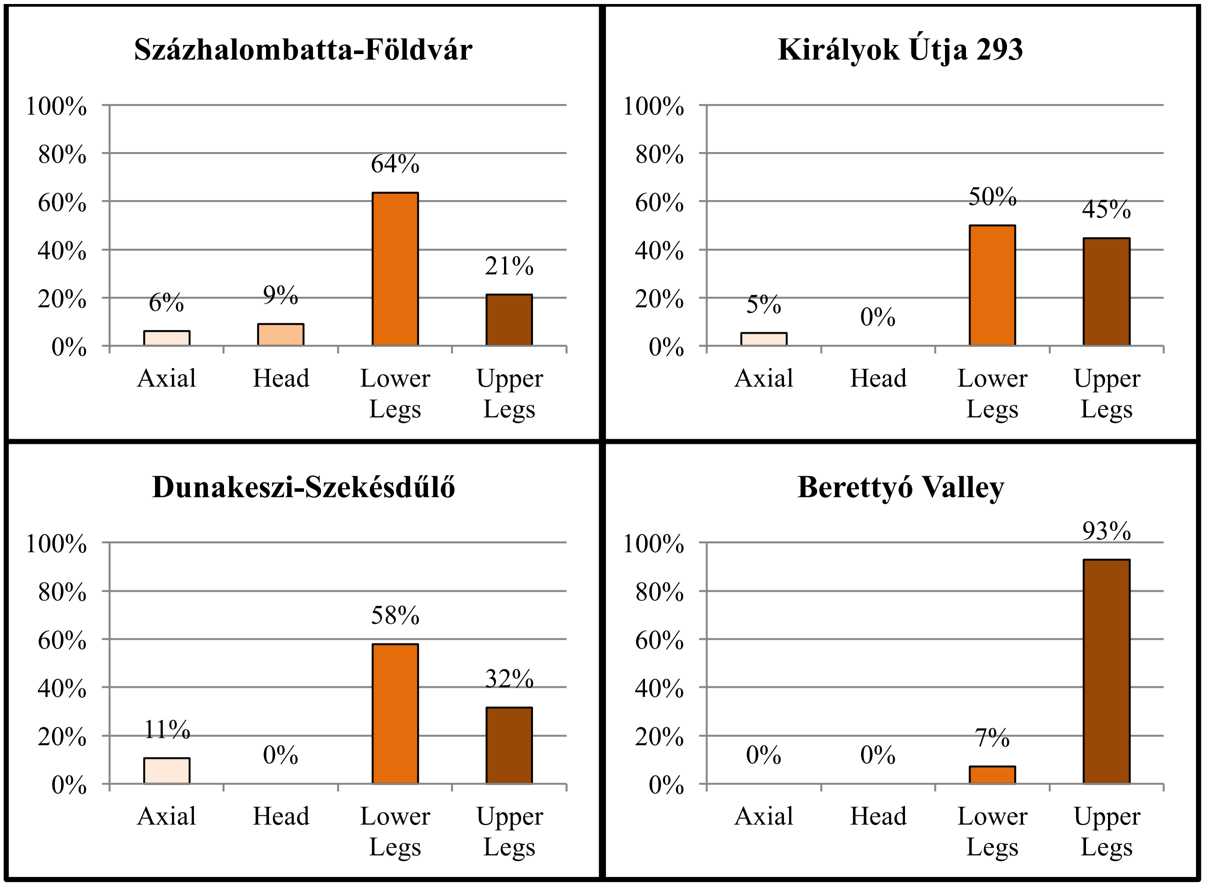

Figure 6.7. Locations of Cut Marks on Horse Bones by Body Region by Site.

The processing the skeletons for hides, sinew, or tools at Dunakeszi-Szekésdűlő, Százhalombatta-Földvár and Királyok Útja 293 is likely based on the overrepresentation of lower limb elements and lower limb elements with cut marks and based my own experience butchering and processing a horse carcass. A few elements, such as the scapula recovered at Százhalombatta-Földvár shown in Vretemark and Sten (2005:Figure 5), show finer filleting, perhaps for consumption. Again, for the most part, cut marks are relatively rare on Bronze Age horse bones, but they are not all that well represented on the other domesticates either, as noted by both Nicodemus (2014) and Lyublyanovics (2016). Even at sites like Százhalombatta-Földvár and Királyok Útja 293 where taphonomy has not damaged the bones to obscure cut marks in significant

ways, cut marks are still low. The Bronze Age butchers were likely quite skilled, used bronze tools, and the lack of cut marks may represent that skill and the qualities of bronze. The EBA sites and the eastern tells have more cut marks overall and more cut marks on meaty elements. This is in line with the regional/cultural patterns I see in the body part representation.

Figure 6.8. Hack Marks on Distal Metapodia from MBA Százhalombatta-Földvár.

Depositional Patterns

Where horses were deposited on a settlement after they died show how they were considered differently through the course of the Bronze Age. Purposeful burial of animals is generally believed to represent their use in ritual or to be evidence of a particular cultural affinity for that species (Reitz and Wing 2008). In the late Nagyrév/early Vatya levels of Dunaújváros-Kosziderpadlás, recently dated to 2139-1981 cal BC, two horse skulls were purposefully buried (Bökönyi 1978; sampled in Gaunitz et al. 2018). This dates to the EBA/MBA transition, one where the Nagyrév/Vatya tell building traditions begin (Jaeger and Kulcsár 2013), animal husbandry

practices shift from cattle to ovacaprids at Százhalombatta-Földvár (Vretemark 2010), and horses disperse but decline in overall numbers. One of these individuals has been recently discovered to be earliest and most basal source of domesticated horse DNA, the earliest known individual of the second lineage of domesticated horses after the earliest domesticated horses from Botai split into two subgroups (Gaunitz et al. 2018). A complete horse skeleton was also excavated from the MBA site of Budapest-Soroksár-Nagyét Site 1, very near the EBA Bell Beaker Csepel-Group sites (Szabó 2002 in Szeverényi et al. 2015). These are the first burials of horses known in Central Europe. The 'bone pile' at Pecica is also further evidence of unusual, purposeful horse deposits (Nicodemus 2014).

Strong statements about the depositional patterns of animal bone must be grounded in detailed knowledge from maps that incorporate GIS data on all elements recovered. While this is a rare practice in the excavation of archaeological sites, Százhalombatta-Földvár was excavated in this very modern way, and somewhat like this for animal bone (Vicze 2005). In pits with mixed deposits or in general fill levels, however, not all elements were mapped. Only general feature associations can be delimited at this time.

At Százhalombatta-Földvár, some tentative statements can be made about the way horses were deposited in pits in house floors, based on the features from which they were recovered. I rely on the notes of the excavators and inventory information for this analysis. The MBA house floors contain clusters of mostly distal limb elements and cranial fragments from a MNI of one to two horses. The general fill areas that were excavated have a slightly higher diversity of elements and up to four (MNI) horses present. At Kiraólyk Útja 293, excavated in a similarly modern way to Százhalombatta-Földvár (Szilas 2009), this pattern is repeated and presence of horses in

buildings is even more apparent. In some pits in buildings here, there are the similar combinations of distal and cranial elements of horses.

These patterns of body part bias at Százhalombatta-Földvár and Királyok Útja 293 could potentially be interpreted as ritual horse head-and-hoof offerings, as identified by Anthony (2007) and Anthony and Brown (2000, 2011). Alternatively, this abundance may be related to the harvesting of phalanx for tools (below, but may also be a ritual element) or consist of residue from processing of horses for hides. In head-and-hoof deposits, only skull and/or mandible fragments and legs of horses are present in a building floor or pit.

Bertašius and Daugnora (2001) describe head-and-hoof offerings as widespread at archaeological sites of many periods throughout eastern and western Europe and Scandinavia. These offerings have been used to denote sacred locations in the Eursian grasslands since the Copper Age. Anthony (2007) provides a reconstruction, based on 20th century ethnographic accounts of Oirot Mongol rituals, of this type of sacrifice that is not buried, but placed outside of the entrances of houses (my interpretation shown in Chapter 3, Figure 3.1). This practice could account for the more fragmentary finds of head-and hoof offerings at Százhalombatta-Földvar related to houses and cultural layers from clustered excavation units that are not yet attributed to structures. The presence of horse head and limb bones together in the absence of other body parts in MBA and LBA house floors and pits may be attributed to ceremonial house offerings. This could also account for the abundance of cut marks on lower limb bones and mandible fragments, which would present like elements processed for hides. In fact, hides could have been taken, and the leftover bones laid to rest in the houses. Finally, this could help to explain why only lower leg bones show traces of dog gnawing, maybe as the offering decomposed and fell to the earth.

Often these deposits contain similar bones from domesticated dogs. At Százhalombatta-Földvár, Vretemark and Sten (2010:87) have noted the overabundance of dog cranial fragments and mandibles in the MBA levels, "It seems probable that, this is not a random phenomenon and that the mixture of bone from dogs, reflects cultural factors. One interpretation is that dog bones to a certain extent, originate from building offerings, where certain body parts were intentionally chosen". I also encountered quite a large number of dog burials while examining the horse bones from the faunal sample at Királyok Útja 293. The implication is an association of horses and dogs in death as in life as special animals with an intimacy with humans in their households. The association of domesticated dogs and horses and horse people is a long tradition that persists from Copper Age contexts (Anthony and Brown 2017). The use of horses and dogs in herding cattle, sheep, and goats is likely not unrelated to their appearance in household pit deposit. Differential treatment of horses and dogs in deposition perhaps show a differential divide in how Bronze Age Hungarians think of them in their daily lives versus other domesticated animals.

As another possibility for this body-part representation, Wilson (1992) suggests that an overrepresentation of head and limb bones of horses may reflect different disposal practices for horses and dogs versus other domesticates or that this pattern reflects processing of horses and dogs for skins and bones to feed to dogs, a case which he documents historically. This last scenario seems less plausible because only a scant 2% of bones in this assemblage have chew marks present and it does not explain why horse head and lower limb bones cluster together repeatedly throughout the site. The gnaw marks are all on lower leg bones and illustrate that these bones were available in some way to dogs at the site.

Ultimately, these potential activities (ritual offerings, tool manufacture, disposal practices, and skin processing) were likely not exclusive of one another. The overrepresentation of horse skull fragments, teeth, and lower limb bones is probably the result of a combination of these uses and the cultural conceptions of horses at Százhalombatta-Földvár and Királyok Útja 293. These ideas about and carcass uses of horses appear to be different than those of cattle and ovacaprids.

Tools

Other specialized use of particular skeletal elements could contribute to their overrepresentation or specialized selection at Hungarian Bronze Age settlements. Choyke (1984:52–53, Table 8) records the percentage of worked horse bone as ranging from 0.8% to 7.0% of the horse bone recovered in faunal materials throughout Bronze Age Hungary. Phalanges were utilized for some tool manufacture, likely as burnishers employed in hide working or pottery production as the palmar surface of the bone is flattened purposefully, or as ritual or game pieces (Choyke 2005b:Figure 9). At Jászdózsa-Kápnolnahalom, the use of horses for these tools or totems increases through time. During the late MBA Koszider phase, Choyke (2005b:137) documents certain attitudes regarding horses:

> The emphasis on horse in the Koszider occupation where the proportion of horse in the refuse bone is much lower compared to the worked sample also suggests these bones were deliberately selected in fulfillment of some symbolic purpose related to attitudes toward horse which came increasingly to the prevalent through time.

Jászdózsa-Kápnolnahalom also has a drilled horse incisor from the late MBA Koszider Phase. This highlights a different and special role of the horse in this period.

> Horse bone starts to be used only at the end of occupation in the form of awls and, most importantly, first phalanges with flattened sides or simple incised decoration…change may

> relate to changes in the iconographic notions of horse within this community's belief system. (ibid:142)

Sled runners and skates made out of horse radii are attested to at EBA BB Albertfalva, MBA Vatya Százhalombatta-Földvár, MBA Királyok Útja 293, MBA/LBA Jászdózsa-Kápnolnahalom, the MBA Mad'arovce settlements of Veselé and Nitriansky Hrádok, and many other sites from later time periods (Choyke and Bartosiewicz 2005; Furmánek et al. 1999). "Skates and runners made from horse radii, the earliest such finds in Europe to date, represent a clear example of a persistent local manufacturing tradition and use" (Choyke and Bartosiewicz 2005:318). Interestingly, the persistence of choosing horse radii, despite the relative clumsiness of the bone compared to metapodia, "in terms of raw material selection, a good argument can be made for continuity in this particular manufacturing tradition. What this tradition reflects in terms of social continuity over the intervening millennium needs to be clarified using other supporting data" (Choyke and Bartosiewicz 2005:319). Although horse bones, particularly radii and phalanges were used as tools and likely in ritual, the frequency of such use was relatively low and probably does not significantly affect the overall body part representation seen across sites from Bronze Age Hungary.

Summary of Thinking About Horses

A general shift is apparent in the cultural significance people placed on horses from the EBA to the MBA of Hungary. Taken in light of the earlier evidence of the widespread influx, extremely high NISP %, and mortality profiles, the body part representation of skeletal elements from archaeological sites of the EBA show a more intensive, balanced exploitation of horses for their carcass products and for use in riding or draught. The MBA brought shifts in equine

demography and geography at settlements. The body part representations, particularly at the Vatya settlements of Százhalombatta-Földvár and Királyok Útja 293, illustrate that horses were treated differently from other livestock. Low utility distal limbs, teeth, crania, and mandibles are overrepresented, while high utility trunk and upper limb bones are generally absent or very poorly represented, except at EBA settlements and MBA Pecica and tells of the Berretyó Valley. This indicates that horses at Vatya sites were probably field dressed where they died and desired carcass products were returned to the main occupational areas of the settlements, unlike cattle or ovacaprids. This substantiates the idea that meat acquisition from horses likely was not a primary goal of carcass utilization by the MBA in most areas of Hungary (Choyke 2000; 2005a; Choyke et al. 2004; Vretemark and Sten 2005; Vretemark 2010) In the MBA and later, the intensity of the probable dietary use of horsemeat of any significance decreased, save for perhaps the Romanian tell of Pecica.

Depositional practices potentially suggest that people may have been selecting certain elements of horse skeletons for specialized deposits on Vatya sites, like head and hoof offerings. The burial of skulls and a complete skeleton at the transition from the EBA to the MBA in this area support this assertion. Processing of horse carcasses for hides is another possibility. Selection of particular skeletal elements for tool use is demonstrated by the creation of skates and sled runners from horse radii, the first evidence of such in Europe. The finds of phalanges that have flattened areas, and some decoration, show that horse bones were chosen as maybe burnishers for pottery or for inclusion in ritual deposits.

Taken together, this evidence does support the earlier research that suggests that horses became a species that was different from cattle, ovacaprids, and pigs to Bronze Age Hungarians.

They were not regularly eaten. This shift occurred as horses became fewer in number and more dispersed throughout the Carpathian Basin. The demographic data of horse populations suggests they were being used for more for riding and less for eating, though these practices continued with variability in the period. The shifting cultural attitudes support this assertion. As horses become dispersed more widely in fewer numbers, the desire to maintain individuals for use in herding, travel, and eventually warfare outstripped their carcass utility.

Material Correlates of Using Horses: The Bits

Horse bridle bit finds provide the most obvious material evidence of where and how people used horses. In the political economy model for the Hungarian Bronze age, they were the institutionalized material expressions of equestrian practices in which link the domestic, political, and ritual economies. For both the Bronze Age in Hungary and throughout Eurasia, they have long been used to prove the long distance contact, trade, and interaction linked to the emergence of an institutionalized warrior elite and warrior aristocracies (Earle and Kristiansen 2010; Kristiansen 2000; Kristiansen and Earle 2015; Kristiansen and Larsson 2005:170–218; Thrane 1999; Treherne 1995; Vandkilde 2014). Kristiansen and Earle (2015:238–239) assert that in the development of political economies of the Hungarian Bronze Age, the “ability to control economic flows in both subsistence and wealth depended on the creation of social institutions with specific cultural formations most importantly involving property rights and the formation of a new type of warrior aristocracy/institution to protect them.” In this vein, a pan-European Bronze Age elite chariot-driving warrior emerged with an ‘international style’ of male habitus that defined the entire epoch (Kristiansen and Larsson 2005:181). The desire of this warrior elite to control the metal trade drove

the growth and formation of the tell settlements in Hungary, and their tell-centered aristocracies. The international flow in metals in this model was,

> connected with reciprocal flows of exports that apparently included…horses…. [and] the emergent political economy shifted towards a world system of trade, transforming the very institutional nature of society…By adding weapons and horses to the cultural inventory, a warrior elite apparently arose as a dominant social segment (Kristiansen and Earle 2015:238–240).

For the material correlates of the institutionalized warrior elite, “we may detect such institutions in the appearance of a package of objects…. in the material indications for the chariot and its derived institutional support, from rock-art pictures in Scandinavia to cheekpieces in the Carpathians and the east Mediterranean” (Earle and Kristiansen 2010:234).

Beyond cheekpieces that were part of horse bits, at the very heart of these ideas, in the proposed supra-regional warrior elite, is also the distribution of the so-called ‘Carpathian-East Mediterranean wave band decoration’ (David 2002, 2007), in German, the *karpatenländish-ostmediterrane Wellenbandornamentik,* often referred to as the *Spiral Motif*, SM hereafter. Various forms of seemingly related decoration occur on some of the horse bridle bit finds from settlements and weapons from the Hajúsámson-Apa hoard contexts centered in the Carpathian Basin. The SM is also found in different contexts in the Aegean, Anatolia, the steppes, and Scandinavia with many expressions of somewhat like designs. The SM has been used to establish links between the regions which range from simple contact to demonstrating evidence of the direct exemplary upon which the tell building societies of the Carpathian Basin are based (Vandkilde 2014:624). Kienlin (2012:290) finds that, “this is done by broad correspondence of formal traits such as with the spiral ornaments”.

The SM has often been assumed to be a foreign import to Hungary, a local imitation of Mycenaean design, indicative of the impact of the Mycenaean polities on the development of the Hungarian tell societies (Earle and Kristiansen 2010:19–22, 233–235, Fig. 8.4a, 8.4b; Hänsel 2002; Kristiansen and Larsson 2005:181). “Indeed, similar warrior gear with swirling cosmology-embedded designs embellishes the pinnacles of the material hierarchies across Europe with highlights in southern Scandinavia, the Carpathian Basin, and the Aegean” (Vandkilde 2014:623). As such, beyond being able to potentially indicate how horses may have been used, the horse bit finds from the Hungarian Bronze Age have been used as key indicators of the political, economic, and cultural character of the Bronze Age of the Old World. Horse bits of the Bronze Age are important.

Why Bits?

To determine the ways in which bits may reflect how people used horses, a bit of background on what they are and why they are used is necessary. Prior to their construction out of bronze in the LBA, bits are represented by the remains of their *cheekpieces* crafted of antler or bone. Cheekpieces are the sides of the bit that lie on either side of the horse’s mouth. In modern bridle and bit terminology, cheekpieces are more commonly known called the shank or cheek on curb bits, or the cheekring or ring on snaffle bits. Archaeologists have referred to this part of the bit as cheekpieces and I continue this for continuity, though in modern bridles, cheekpieces refer to the pair of leather straps that connect the bit to the crown piece (Figure 6.9). The use of this term by archaeologists may be due to translations of bridle and bit parts from other languages into English. The basic bridle form has remained the same for millennia. Artist’s reconstructions of Bronze Age bridles are shown in Figure 6.10 and 6.11. Straps, made from leather or other forms

of organic cording, connect the bit to the head and were passed through dividers made of antler or bone, also found in Bronze Age Hungary (Bándi 1963).

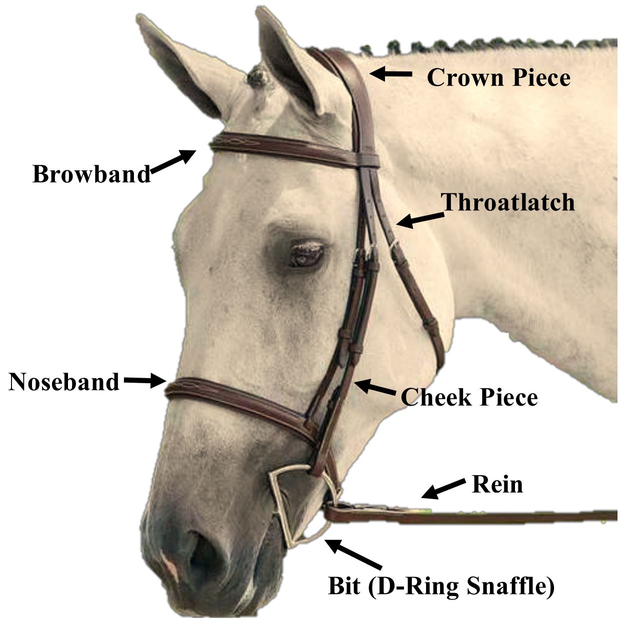

Figure 6.9. Parts of a Modern Bridle.

Figure 6.10. Reconstruction of a Bronze Age Bridle of Hungary (drawing by Ágostan Dékányi in Choyke 2005b:140, Figure 12). There probably should be a noseband to make this bridle functional.

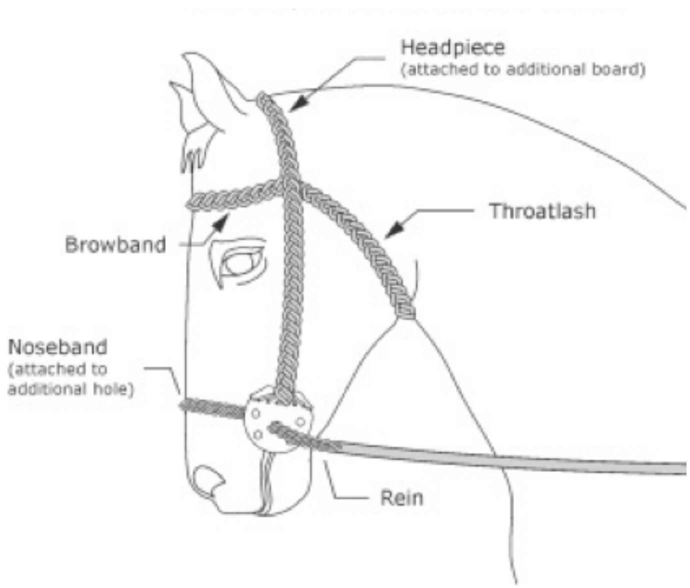

Figure 6.11. Reconstruction of a Bronze Age Bridle of the Eurasian Steppes (drawing by Chechushkov, Epimakhov, and Bersenev 2018). Throatlatch called "throatlash" in Europe.

Figure 6.12. Examples of Bronze Age and Modern Bits.
Top Row: (L) Bronze Age Cheekpieces from Százhalombatta-Földvár with Suggested Braided Rawhide Mouthpiece; (C) Modern Curb Bit (Western); (R) Modern Curb Bit (English Pelham, Hooks are for Curb Chain).
Bottom Row: (L) Bronze Age Cheekpieces from Starouir'evo Kurgan with Suggested Braided Rawhide Mouthpiece; (C) Modern Snaffle Bit (Eggbutt); (R) Modern Snaffle Bit (Full Cheek).

Figure 6.12 illustrates the cheekpieces found in the Bronze Age of Hungary and Eurasia compared with modern bits. The bit's mouthpiece lies on the *bars* of the mandible, the lucky and unique diastema between the incisors and premolars in the horse's mouth, that allow for horses to be bitted (Figure 6.13).

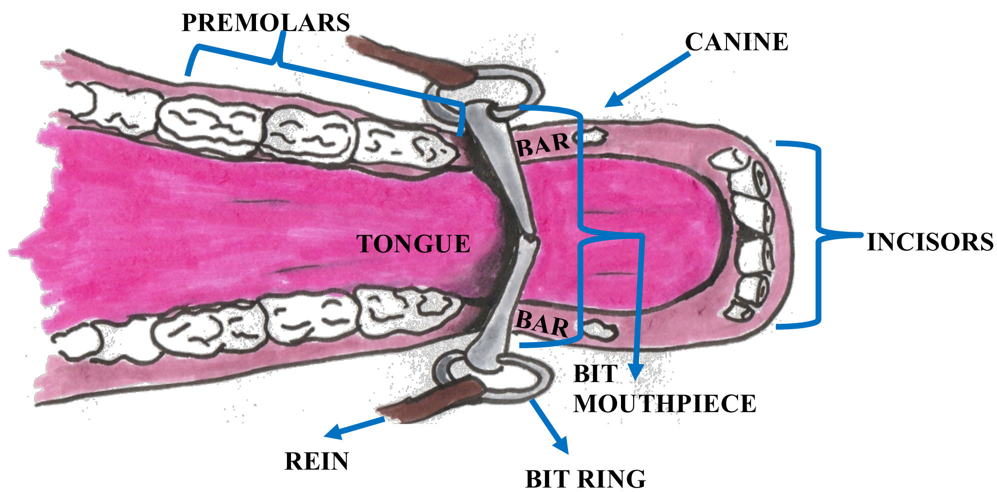

Figure 6.13. Diagram of Bit in Horse's Mouth Looking Rostrally to Mandible.

Bits are not necessary for riding or driving horses (Brownrigg 2006; Dietz 1992; Hüttel 1994; Junkelmann 1992). Horses can perform at the highest level of equestrian competitions and in cavalry or warfare without wearing bits, or even bridles in some cases (Cook et al. 2003; Dietz 2003). Training a horse to respond at a high level without a bit requires a very skilled trainer and rider. The Numidian cavalry c. 200 BC were famous for riding bareback into battle with only a rope ring around the horse's neck (Sidnell 2007).

The question of why bits were even developed is an interesting one. The cheekpieces that survive as the material evidence for bits may have been created out of a necessity for steering while

driving at higher rates of speed, such as with chariots, so that the mouthpiece was not pulled through the sides horse's mouth while driving (Dietz 1992; Littauer 1969; Littauer and Crouwel 1979; Moorey 1986). Control, especially when turning a wheeled vehicle, and access to greater speed may have been improved with a bit with solid and spiked cheekpieces, which was then increased with the use of solid mouthpieces (Dietz 2003). There is not a clear answer however. Expert equestrians agree that controlling horses with bits is rather an illusion; even with the most severe bits a horse can bolt (run away), rear, and otherwise perform in ways to unseat the rider (Hartley Edwards 1990; 1994).

At the extremes, bits can alternately provide an especially fine line of communication with the ridden or driven horse which is developed over long-term training or they can provide incredible pain. They typically do both simultaneously to varying degrees. Although trained to respond to bits, the horse reacts to them in a number of predictable ways (Clayton and Lee 1984; Manfredi and Clayton 2005, 2009) (Figure 6.14).

> The rider controls the horse using a coordinated system of aids which the horse has been trained to obey. The rider's hands, acting via the reins, exert pressure on various parts of the head. The precise mechanism of action of a bit depends on its shape, the attachment of the reins relative to the position of the mouthpiece and the height of the rider's hands. Seven pressure points are described: (l) the tongue; (2) the bars of the mouth; (3) the lips; (4) the curb groove; (5) the poll; (6) the nose and (7) the roof of the mouth. (Clayton 1999:76)

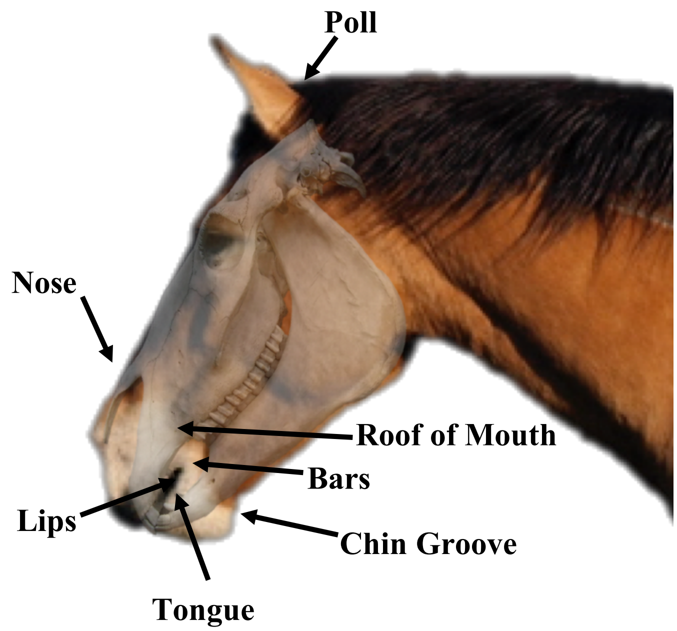

Figure 6.14. Seven Pressure Points of the Bit.

The wear from bits on horse teeth has been demonstrated at the earliest certain site of domestication at Botai, but no secure evidence of cheekpieces or other bit or bridle artifacts of the Copper Age have yet been found (Anthony 2007; Anthony and Brown 2011; Anthony et al. 2006; Gaunitz et al. 2018; Outram et al. 2009). Possible antler cheekpieces from Copper Age contexts have been the subject of much debate (Telegin 1986). The attribution of these pieces as cheekpieces is quite controversial as they could be tools for other endeavors, and the original artifacts have been lost (Anthony and Brown 2011; Dietz 1992). Early bits were likely made of organic materials that have not survived. American Indians of the Plains rode and fought on horseback with a simple thong bridle (often called a war bridle) tied around the lower jaw of the horse (Ewers 1955). This is an example a very effective bridle bit that would not survive archaeologically. Also highly likely were so-called ‘bitless bridles’, which probably were the

earliest form of bridles, and leave no evidence of wear on teeth. They act on the sensitive portions of the horse's head without the necessity of a bit, though Taylor et al. (2016) has developed a reliable technique for detecting changes in the equine skull from such devices, proven on much later Iron Age horses from Mongolia. The bits represented by the first cheekpieces were used with soft mouthpieces also of organic materials such as leather, horsehair, or plant materials. The evidence of bit wear and my analysis of bit wear on horse teeth and mandibles from Hungary is discussed in Chapter 7.

I suspect two things related to the balance and steering of the rider may be at play in Bronze Age Hungary: 1) as horses spread from the Bell Beaker sites on the Danube bend, more people were exposed to horses than had been before. Bit technologies may have developed and expanded because more people that were less experienced with horses began riding; and 2) that this cheekpiece and bit technology assisted the balance of riders who began carrying something else in their hands, such as a herding implement like a lasso or cane, or a weapon. Because they apply more pressure to the head, bitless bridles often cause the horse to over bend at the poll (the top of the head; shown in Figure 6.14 above) and make it more difficult to use the reins as a point of balance.

The issues of rider balance and steering were probably important to bit development as were who were using horses, for what purpose, at what frequency, and over what terrain. It is easier for an inexperienced rider or driver to convey instructions to a horse with a bit or a stronger bit. It is also easier for someone consistently riding with the reins in one hand, as with a herding tool or a weapon, to convey instructions to a horse with a bit or a stronger bit and to balance. Stirrups are not known for certain until 300 AD. Balance is rarely mentioned as a reason for bits

or certain bitting developments, as a rider or driver who balances on the reins and the horse's mouth are an anathema to modern equestrians everywhere. However, it is the rule, rather than the exception, that the reins and the horse's mouth are used for balance now as it was then. In turn, it also balances the horse to some degree. Contact with the horse's mouth via the reins is also variously desired in modern equestrian disciplines to balance horse and rider: from generous contact with the horse 'in the bridle' and 'on the bit' in *dressage* to virtually no direct contact with the horse through the bit with the horse in working cow horse Western disciplines. The horse can perform at the highest levels at either end of the spectrum. What is desired of the horse, and how it is trained to do what is asked, affects the range of contact with the bit a rider may have. This is, however, a much larger line of inquiry outside the direct scope of this research.

In sum, there are not many scientifically derived or supported theories as to why riders and drivers use bits, but most agree that an increase in the desire for finer steering and control (whatever that may actually entail is unclear) are the two central reasons as to why the material correlates for bits appeared at the dawn of the European Bronze Age. There also could be a simpler explanation in Hungary such as the increased exploitation and widespread availability of the red deer, from whose antlers the cheekpieces are made (Choyke 1984, 1987, 1998, 2005a). Red deer typically reside in mixed deciduous forest of lowlands and mountains, and were rare on the steppes at the time. Antler could have replaced earlier wooden or other organic cheekpieces. I also add the balance of the rider, potentially to free one hand for use in herding or fighting, and the possible necessity of bits with cheekpieces during the expansion of equestrianism to new peoples. The amazing thing is that bit technology and function have remained relatively similar and stable for the last four thousand years.

More than a Bit of a Problem

The study of horse bits, and thus how horses were used in the Bronze Age, is fraught with a number of related maladies. It is marred with many older and scientifically unsubstantiated assumptions. There are two main problems: 1) outdated ideas about horses during prehistory, and 2) chronological issues. These problems stem from a compounding of dated misunderstandings of the following topics: the character of horse domestication, the dispersal of domesticated horses, how horses were first used, the nature of riding and driving, who first rode or drove horses, and the impact of the Near East, Aegean, Egypt, and Anatolia in the spread of horses and equestrianism. Additionally, the tangle of multiple relative chronologies developed for the European Bronze Age was often partly based on horse bits. This has led to the increasing errors in the interpretations of horse bit finds and early horse use.

We now know that horses were domesticated (or undergoing domestication) for certain by 3500 BC in Kazakhstan, and they subsequently spread to Europe millennia before they reached the Near East or the Aegean (Gaunitz et al. 2018; Outram et al. 2009). Riding was suggested to have been a part of horse domestication (Azzaroli 1985; Bökönyi 1978; Clutton-Brock 1992; Hüttel 1994; Jankovitz 2016; Lamberg-Karlovsky 2002; Littauer et al. 2002), and now has been documented from these earliest stages (Anthony 2007; Anthony and Brown 2011; Anthony and Brown 1991; Anthony et al. 2006). While early riding was hotly contested (Levine 1999a; 2004) a strong consensus in archaeology and genetics has come to rest on the side of riding likely accompanying domestication and its subsequent spread to the Carpathian Basin with migrating peoples in the Copper Age and EBA (Batini et al. 2015; Cunliffe 2008; 2015; Goldberg et al. 2017;

Haak et al. 2015; Mathieson et al. 2018; Olalde et al. 2017; 2018; Outram et al. 2009; Seetah et al. 2016).

In much of the twentieth century, there was a persistent and earnest desire to place chariotry before riding for not very scientific reasons. This persisted most probably related to a stubbornness to admit that equestrianism did originate and was established in Europe first before disseminating to urban (read *civilized*) cultures. The earliest images discovered of horses in the urban civilizations saw them hitched to chariots. Chariotry first, and *then* riding, was thought to originate in the Near East, Anatolia, or the Aegean and then spread to Europe, especially prior to an understanding of the steppe origin and early uses of domesticated horses (Drews 2004, 2017; Moorey 1986; review in Pinheiro 2010). It was thought that only in the 'High Cultures' of the Old World, could such lofty skills and 'fully developed' equestrianism emanates. This outdated sentiment is best summed up by Drews (2004:62), "That people along the Danube should have been expert riders a millennia before people in Greece learned to ride properly, and that equestrian skills were brought to the Near East from the Balkans is a fairly remote possibility".

The assumptions of why chariotry precluding riding variously included the following; that horses were too small, earlier domesticated horses were somehow less controllable, horses would be calmer and more tractable hitched to chariots, bits with soft mouthpieces were not adequate to provide enough control for riding, metal bits were necessary for mounted warfare, horses were 'inexpertly' or 'ineffectively' ridden based on images of ridden equids in Near Eastern art, or that riding couldn't have been developed before 1000 BC because it didn't become prevalent in the Near East or the Aegean before then (Archer 2010; Dietz 2003; Drews 2004; 2017; Kelekna 2009;

Kuzmina 2003; Oates 2003; Renfrew 1990; Sherratt 1997b; Wiesner 1968). Pinheiro (2010:34–35) summarizes these arguments:

> In comparison with modern-day horses, Bronze Age horses were little more than sturdy ponies. While some could carry a man, they certainly could not endure the hardships of battle. They could not carry a fully armoured warrior for long periods of time, and being an animal with a fight or flight response heavily geared towards flight, in the case of mares and geldings, or of extreme aggression, in the case of stallions; it would be extremely difficult to manage in any sort of formation or tactical use. While this was no serious drawback in earlier tribal warfare, when the horse served as transportation to light-armoured warriors, during the Sintashta period, where large-scale battles were fought between large groups of organized, and judging by their graves, heavily-armed troops, the horse simply could not be used effectively in the battlefield. It was possible to use it as a mount, but it wasn't possible to use it as cavalry. It is reasonable to expect that Sintashta warriors were aware of the horses' potential as a weapon. However, a way to circumvent its natural limitations had to be found before horses could be used to full effect on the battlefield. The chariot is the solution to this problem.

Horses were clearly big enough and sturdy enough to carry riders from the beginnings of domestication through the Bronze Age (Chapter 5) (Anthony and Brown 2011). There are no scientific reasons to assume that the tameable nature of the earliest domesticated horses were substantially different from later prehistoric ridden horses or modern horses, which would require them to be driven for millennia after domestication rather than ridden. Driving horses is not easier or safer. Selection for tameability was part of horse domestication (Librado et al. 2017; Schubert et al. 2014). Metal bits are clearly not a requirement for control, performance at the highest levels, or use mounted warfare or cavalry either. The Numidian cavalry and many indigenous cultures of the Americas exemplify this. The idea that somehow people who had domesticated horses and lived with them and used them for millennia would be inexpert or ineffective riders is never substantiated with anything more than ill-informed conjecture. The greater likelihood is that they *were* expert riders.

Images of Near Eastern people riding equids were often used to refute earlier competent European riding of horses. These images were likely reflective of their own long-term traditions of riding and driving donkeys and asses, who are substantially different to drive and ride from horses. Importantly, riding may have been deemed unseemly for a ruler, probably because of the effort and time required to become an accomplished horse rider by peoples who were used to only occasionally riding other quieter equids, and received horses from other regions. It is rather easy to look ridiculous on a horse when one is not a rider or even is a rider who is out of practice. A Sumerian king was advised to avoid riding horses c. 1779-1761 BC: "Let my lord not ride horses. Let him mount only chariots or mules and honor his kingly head" (Gordon 1958:19 in Owen 1991:12). More recent finds also refute the earlier claims of chariotry preceding riding. The earliest Mesopotamian images of horses show them ridden. No images from this early period show chariots.

> Certainly wheeled vehicles preceded horseback riding in the Near East, and horse-drawn chariots dominated Near Eastern warfare long before cavalry, but this was not because riding was invented after chariotry. If images of horseback riding can now be dated before 1800 BCE, as it seems to be the case, they preceded the appearance of horses with chariots in Near Eastern Art (Anthony 2007:503).

Chariotry came much later, after riding was already practiced for several millennia. Wagons had been in use for even longer, drawn by cattle or oxen, evidenced by traction induced pathologies on these species (Bartosiewicz, Van Neer, and Lentacker 1997; Bondár 2012:21–22; Ghetie and Mateesco 1971). Wagons were present in Hungary from the late Copper Age in Hungary and wagon models similar to those found in the Copper Age were found regularly in the Bronze Age (Chapter 3), summary in Bondár (2012). Like those found in the Copper Age, the Bronze Age wagon models and their associated wheels were all four wheeled models, or fragments

thereof, not two like the chariot. This point is mostly ignored when the wagon and wheel models are used to forward the idea that chariotry was present in the EBA/MBA Carpathian Basin (Nicodemus 2014; Pare 1992; 2004). These wagon and wheel models are neither directly related to nor indicative of chariotry in Bronze Age Hungary. There is also a great likelihood that the wheel models are misidentified spindle whorls. The only known image of a chariot in the region comes in the LBA, dated to after the 14th century BC from the site of Vel'ké Raškovce in northeastern Slovakia (Boroffka 1998; Bátora and Vladár 2002:178–179). The two spoked-wheeled horse-drawn chariot has been known since 2100-1800 cal BC in the Kazakh steppes, where horses were found buried with chariots, disc-shaped spiked bits, people, and new types of weapons (Anthony 2007, 2009; Bocharev et al. 2010a; 2010b; Chechushkov 2013; Chechushkov et al. 2018; Chechushkov and Yepimakhov 2010; Gening et al. 1992; Kohl 2007; Koryakova and Epimakhov 2007; Kuznetsov 2006; Lichardus and Vladár 1996; Outram et al. 2011; Piggott 1983; 1992; Pinheiro 2010; 2011).

Riding and the Bridle Circle of the Bronze Age Carpathian Basin

Bits finds of the Hungarian Bronze Age are almost entirely represented by rod-shaped cheekpieces of bits made from the antler of Red Deer (Bándi 1963; Bökönyi 1953; Choyke 1984; 2005b; Hüttel 1981; Kovács 1969; Mozsolics 1953). These rod-shaped cheekpieces (*Stangenknebel* in German), in conjunction with the circular, disc-shaped cheekpieces (*Scheibenknebel* in German) from the Sintashta and related chariot burials, are the earliest certain and agreed upon evidence of the finds of bits (Figure 6.16). No mouthpieces for horse bits have been found in the region until bits here become made of bronze around 13th century BC (Boroffka

1998; Hüttel 1981; 1994). Bits are not found outside of the Carpathian Basin or the Don-Volga-Urals area until the 17th century BC.

Hüttel's (1981) incredibly throrough and masterful compendium of the bit finds of Bronze Age Europe is the starting point to demonstrate that riding continued and chariotry was developed in separate geographic, cultural, and equestrian circles. Accepting that riding accompanied domestication and that horses were ridden into the Carpathian Basin in the LCA and EBA, then bit and bridling traditions of the Hungarian Bronze Age most likely grew out of long-established riding bit precursors. Defining riding versus driving on the basis of bit types, rod versus disc shaped cheekpieces, has been proposed as a reasonable hypothesis (Littauer and Crouwel 1996; Metzner-Nebelsick 2013:336–337). Hüttel, after composing the compendium, linked the rod-shaped cheekpieces with riding (1982), and believed riding to herd preceded chariotry (1994), as did Pare (1987). Combining both archaeological and experimental evidence, Chechushkov, Eimakhov, and Bersenev (2018) recently substantiated the idea that the disc cheekpieces were used for chariotry and the rod form was used for riding.

Hüttel (1981) termed the different traditions of bitting in the Bronze Age as *Trensenkreis* (in German) or 'Bridle Circles". One was centered on the Carpathian Basin and one on the Don-Volga-Ural steppes. He repeatedly stressed that these bridle circles were autochthonous developments in each region, with different local precursors. He convincingly showed that cheekpieces in a rod form of antler were predominant in the Carpathian Basin and cheeckpieces in a disc form of bone or rectangular form of bone (*Plattenknebel* in German) were centered on the steppes. Hüttel (1981:74):

> Dennoch kommen weder Mykenai noch Osteuropa als Anreger der altbronzezeitlichen Trensentwicklung im Karpatenbecken in Betracht. Mykenai und Osteuopa sind beide

> durch eine grundsätzlich (auch genetish) vershiedene Zäumungsauffassung mit entsprechend wesensverschiedenem Instrumentarium vom Karpatenbecken unterschieden. Dominieren an der mittleren Donau Stangenknebelformen, so in der Ägäis und den osteuropäischen Steppen Scheiben- und Plattenknebel.
>
> Yet neither Mycenae nor Eastern Europe are considered as stimulators of the ancient Bronze Age bridle bit development in the Carpathian Basin. Mycenaean and Eastern Europe are both distinguished by a fundamentally (also genetically) different bridle view with correspondingly different instruments from the Carpathian Basin. On the Middle Danube rod cheekpiece forms dominate, and in the Aegean and the Eastern European steppes, disc and plate cheekpieces domintate.

Hüttel also identified a category he called the "contamination form" which seemingly combined both rod and disc into one bit. Several following authors developed their own bit typologies and variants (Boroffka 1998; Penner 1998) as did earlier authors (Mozsolics 1953), which Hüttel used in forming his types. They generally follow Hüttel's four basic types: rod (including the *Zapfenknebel* in German, or "pin cheekpieces"), disc, rectangular, and contamination, but differ on the variant types within these larger categories. I defer to Hüttel's original four larger designations as well as his discussions of the variants of these forms (Figure 6.15).

Figure 6.15. Examples of Hüttel's (1981) General Bit Categories.
Top Left: Rod or *Stangenknebel* (Százhalombatta-Földvár, Hungary); Top Right: Disc or *Scheibenknebel* (Starouir'evo, Russia); Bottom Left: Rectangular or *Plattenknebel* (Komorakova, Russia); Bottom Right: Contamination or *Kontaminationsform* (Tószeg Laposhálom, Hungary).

The cheekpieces found in Hungary (Figure 6.16) are absolutely unlike those found with the chariot horses, save a few disputed pieces. The Hungarian bits would have functioned quite differently from the steppe ones. However, I am not entirely sure that the artist's interpretations of how the Hungarian pieces function is correct, as these reconstructions were based on later Assyrian depictions (Figure 6.10). They don't exactly match the Assyrian depictions either, as in these the reins are shown at the distal end of the cheekpieces, not attached to the mouthpiece. I have always thought the bits were shown upside down and not attached to the bridle in a way that made sense. They appear to me that they would operate like a curb bit, although this is another discussion.

Figure 6.16. Examples of Early and Middle Bronze Age Rod Antler Cheekpieces and Strap Dividers (Poroszlai 2003a:143, Figure 2).

None of the cheekpiece finds from Hungary have been radiocarbon dated to my knowledge. The only recent cheekpiece find with secure dating from an associated radiocarbon date is from

Pecica, and dates between 2000 and 1750 cal BC (Nicodemus 2014:481). The cheekpieces have been documented and discussed on the basis of relative chronologies, most thoroughly using Hänsel's (1968) scheme (Hüttel 1981). Most of the cheekpieces were found in the early part of the twentieth century, and precise dating from settlements is either relative or unknown. Generally, though, "The earliest bridle bits from clear contexts can be put into the time of the stage Early Danubian (Hänsel FD III) Reinecke BrA2. In absolute chronological terms, according to current knowledge, this corresponds approximately to the period between 2000 and 1700 BC" (Boroffka 1998:103). The most recent radiocarbon dating reported (Jaeger and Kulcsár 2013) from settlements that have the most bits are as follows: Füzesabony (1903-1613 cal BC); Tószeg (1927-1631 cal BC); and Százhalombatta-Földvár (1912-1400 cal BC). Gösdorf et al. (2004) reports that the Hatvan/Ottomány Horizon dates from 1890-1750 BC and the Ottomány/Füzesabony Horizon runs from 1890-1750 cal BC. The Classical Vatya dates from 2000/1900-1900/1700 BC (Jaeger and Kulcsár 2013). These are the horizons with the most bits. The Bronze Age Danubian bridle bits were most certainly in use from the earliest part of the MBA, rather than the latter period where they had been erroneously placed. Known terminal MBA Koszider bit finds have not been documented, although this is the period to which they were most often attributed in the past.

Hüttel (1981) uses Hänsel's (1968) chronology to assign relative dates from the known horse bit finds of the Bronze Age. However, Hänsel's chronology is not widely used in Hungary. Fischl et al. (2015) put Reinecke BrA2a-c from 2000/1900 to 1700/1600 BC, with BrA1b beginning in the Late EBA, BrA2 at the beginning of the MBA. The beginning of the Hungarian MBA is contemporaneous to the beginning of the BrA2 period, from 2000/1900 BC to 1700/1600 BC, and the Koszider period BrB from 1600 BC to 1500/1450 BC, with some apparently Koszider

dates from 1800-1600 BC though, (Jaeger and Kulcsár 2013). The Hänsel (1968) FD III = BrA2 is currently in line with Boroffka's 2000-1700 BC statement, and has implications for understanding the relationships between bit development in Hungary, the SM, and contacts with the Aegean. The dating of the EBA and MBA horse bits of Bronze Age Hungary is now pushed earlier by several centuries.

I mapped all of the earlier Hungarian bit finds by period, along with more recent finds from Százhalombatta-Földvár and described in the literature from other Bronze age sites (Boroffka 1998; Dani 2012; Nicodemus 2014; Máthé 1988). There were 104 total bits in this inventory from the Carpathian Basin (including Romania): 14 EBA (Figure 6.17), 79 MBA (Figure 6.18), and 9 LBA (Figure 6.19). They cover the entire region beginning in the EBA and spread decisively with the spread of horses in the MBA. By the LBA, they decrease in finds, but increase substantially when made of bronze in the Early Iron Age. Also in the LBA, bits (and horses) spread considerably west and north.

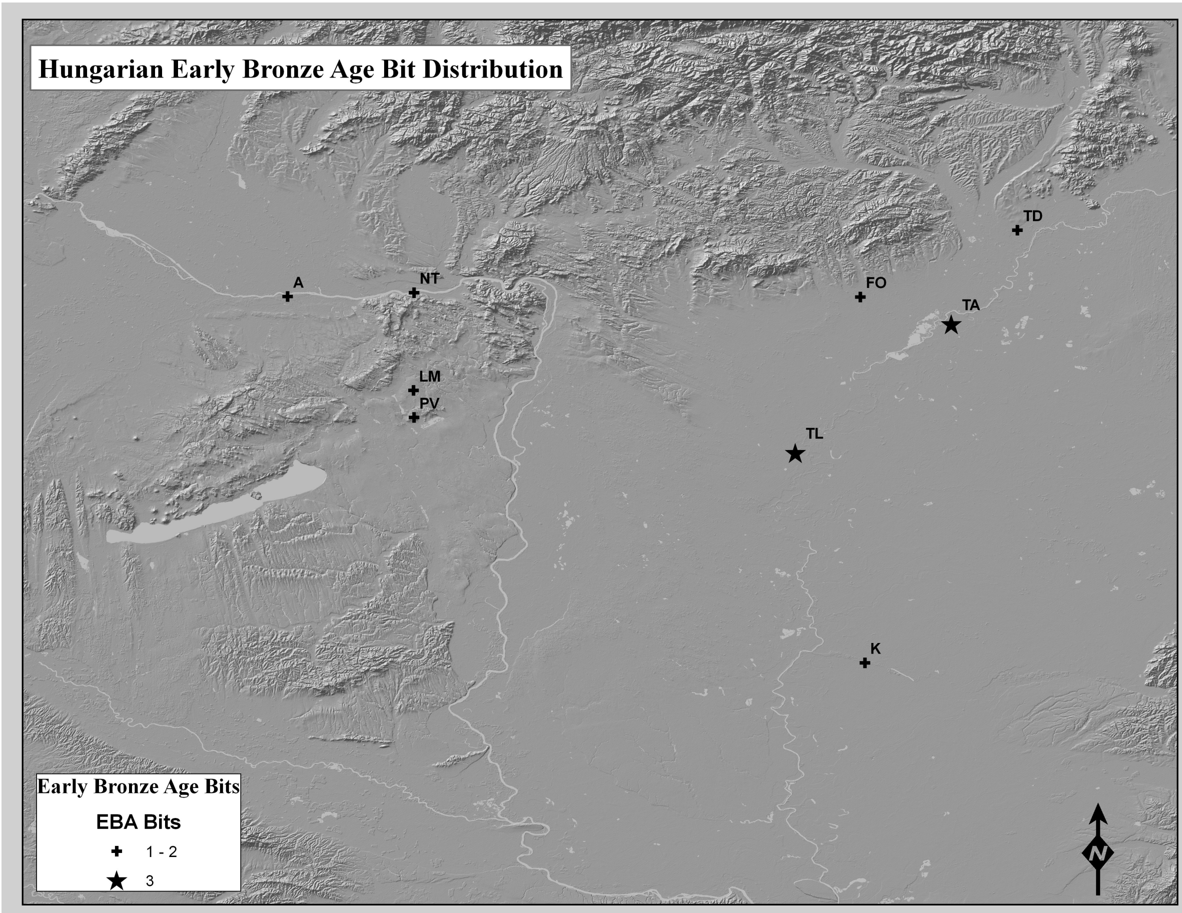

Figure 6.17. EBA Hungarian Bit Finds.

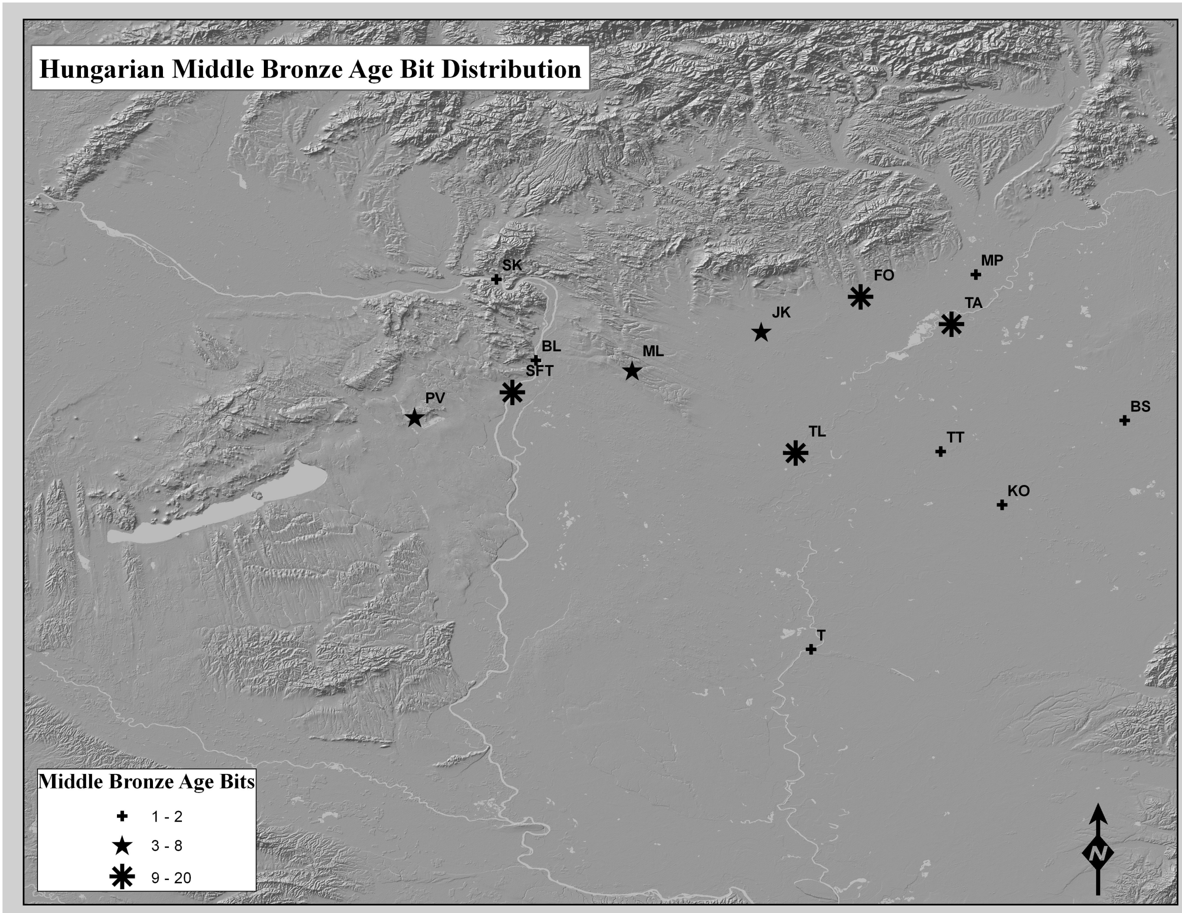

Figure 6.18. MBA Hungarian Bit Finds.

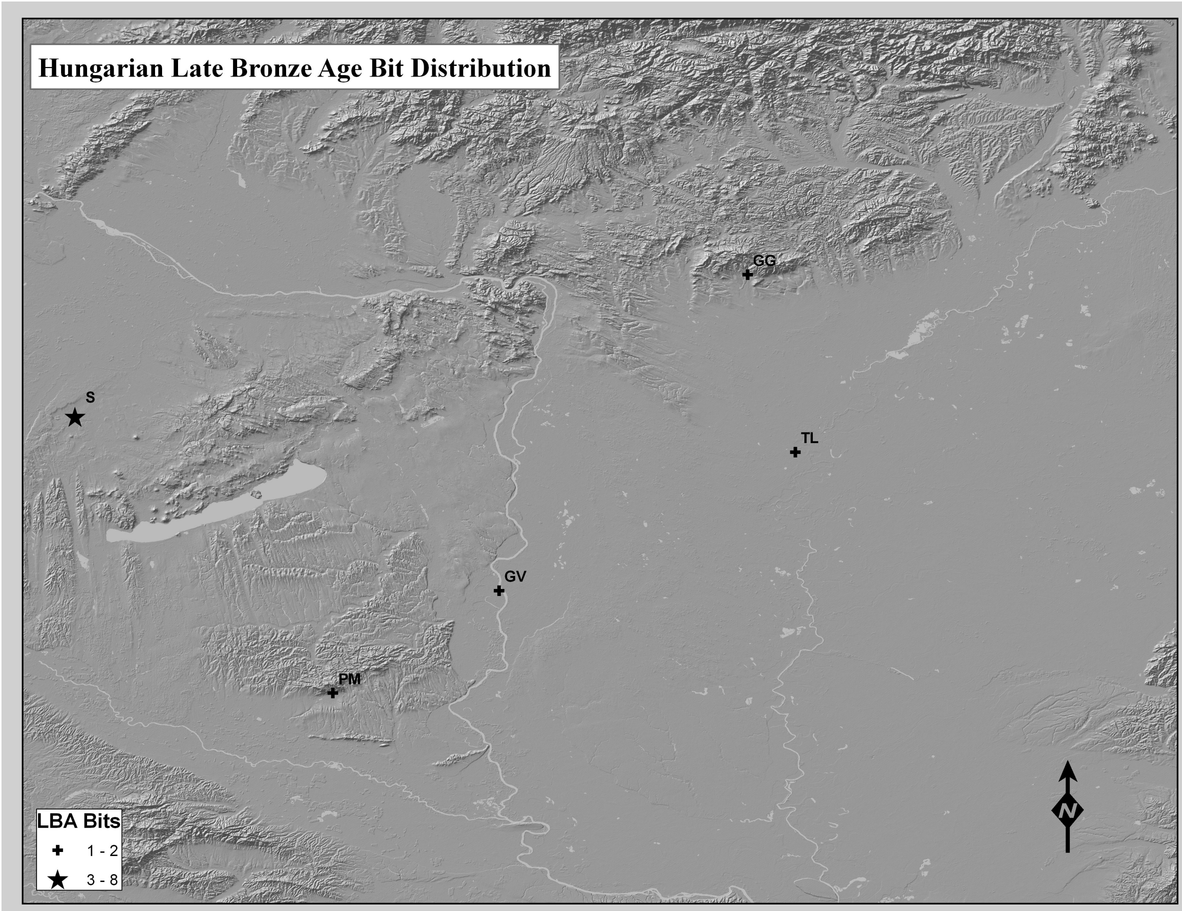

Figure 6.19. LBA Hungarian Bit Finds.

Neither the décor nor form exactly matches the periods. The décor is rather varied, with 62.75% that are decorated: 14.71% are decorated with what is considered the SM as defined by David (2007), 12.5% have an 'eye motif', but 64.06% are decorated with geometric or scratched motifs that are not like the SM. Although previously believed to be diagnostic of the period or culture (Hüttel 1981), the SM spans the entire EBA/MBA bit inventory, as is not represented by any one culture (Boroffka 1998; Choyke and Bartosiewicz 2009). In fact, all of the tell cultures have bits decorated with the SM. David (2007:413–414) who examined the décor in thorough detail explains,

> The Danubian finds are characterized by a relatively wide distribution between eastern Bavaria or southern Moravia and the southeast border of the Carpathian Mountians. They show no particular ties to any specific cultural group. Rather, objects decorated with this characteristic motif [the SM] occur equally among the cultural groups of Mad'arovce-Věteřov-Böheimkirchen, Vatya, Periam-Pecica, Maros/Mureş, Vatin-Vattina, Füzesabony-Otomani-, Gyulavarsánd-Otomani, Wietenberg and Monteoru. It should however be pointed out that only some of the horse bits…are decorated with this 'international system,' so to say. The majority of objects have little or no decoration. But on Danubian bone objects the characteristic wave and whirl patterns can also be combined with patterns which are, so far at least, without direct parallels on bone objects from the Peloponnese or Anatolia.

The largest numbers of bits come from the tell settlements of the Hatvan/Ottomány/Füzesabony at Tószeg-Laposhálom (21), Tiszafúred-Assothálom (15) and Füzesabony-Öregdomb (15); and the Vatya at Száhalombatta-Földvár (14), but all of the tell cultures have had bits recovered from at least one settlement. All of the bit finds are from settlement contexts, some known from housefloors such as the five recently found at Százhalombatta-Földvár. The bit finds from this housefloor were near some horse bones, but the complicated nature of the pits on this site make it difficult to say if they were chronologically connected. Relatively little data is available about contexts other than generalized levels. However, to be clear, *none* of the Hungarian antler or bone bit finds of the EBA and MBA have been recovered in association with any weapons or any wheeled vehicles or in graves or hoards.

The most referred to evidence of chariotry based on cheekpiece finds in the Central European Bronze Age comes from what Hüttel (1981) terms *Einfache Scheibenknebel* (in German) or "Simple Disc Cheekpieces". Shown in the bottom left of Figure 6.17 is an example from Tiszafüred-Ásotthálom. These 5 possible cheekpieces, four of bone and one of antler, comprise 5.10% (n=5) of cheekpiece finds in Hungary and 3.93 % of Bronze Age cheekpiece finds in total, but are often given as decisive evidence of chariotry, along with the SM which occurs only on a

minority of the rod cheekpieces in Hungary (Kristiansen in Allentoft et al. 2015 supplement; Vandkilde 2014). These cheekpieces date from Hänsel FD III to MD I contexts, according to Hüttel, which broadly places them in the period 2000/1900 BC to 1500/1450 BC, Reinecke BrB. However, Bándi (1963) initially described 4 of these pieces as *Reinmenteiler* (in German) or "strap dividers" used to organize the straps of leather or other organic materials that make up the bridle as it is fitted to the horse's head (Figure 6.17). He identified through trace wear analysis how the straps went through these pieces in a way that was unlike the wear that would result from these being cheekpieces. He added an additional 8 pieces, 7 triangular made from the branch of red deer antler, also as strap dividers. All agreed that these pieces were related to horse bridling, but Hüttel follows Pottraz (1966), disagrees with Bándi and argues, with admitted reserve, that they are cheekpieces similar to those from the Kazakh steppes to Mycenae. It is unclear if Hüttel (1981:51–55) ever viewed these bits in person, but he clearly stated his interpretation was controversial.

The notable and significant difference between the steppe disc cheekpieces, those in Mycenae, and these discs, is the lack of spikes on their inner face, which put pressure on the horse's mouth when turning. The steppe disc bits overwhelmingly have these spikes (Bochkarev and Kuznetsov 2013). While the round bone discs from Hungary could ostensibly be used as cheekpieces, there are no parallels to the simple type; they are unlike the chariot related spiked disc cheekpieces or other cheekpieces from any area. They do not occur outside of Hungary. Neither do the triangular forms attributed by Bándi (1963) as bridle strap dividers. Use-wear analysis and their singular appearance identify these pieces as bridle strap dividers.

Although Hüttel cautioned against an absolute attribution as cheekpieces, his tentative supposition that these could be Mycenaean related chariot cheekpieces has been repeated since

without question (Kristiansen 2000; Kristiansen in Allentoft et al. 2015 supplement; Kristiansen and Larsson 2005; Vandkilde 2014). It must be remembered that Hüttel in 1981 was still operating under the assumption of chariotry having a Near Eastern origin, whose supposed dispersal into Central Europe was mediated by Mycenae, a faulty assumption still repeated (Vandkilde 2014:624). Using the four disc-shaped pieces as definitive evidence of chariotry in Bronze Age Hungary is unfounded. There are five studded disc cheekpieces recovered in Romania, two of which are within the basin, three just east of the Carpathians, in the foothills (Boroffka 1998). The two cheekpieces just within the Carpathian Basin probably do reflect limited contact and trade with steppe chariot peoples. But as Hüttel (1981) repeatedly stresses, this is a sporadic, inconsequential influence on the development of bitting technologies here.

Contamination form cheekpieces are also present in the Hungarian Bronze Age. They comprise 2.94% (n=4) of the Hungarian cheekpiece finds. There are 2 of these cheekpieces from Tószeg-Laposhálom and 2 from Vatin. They do not have spikes and may worked like rod shaped cheekpieces as lever or a curb type bit. They are present on the steppes as well (Bochkarev and P. F. Kuznetsov 2013:75–76; Hüttel 1981:59–64)). One cheekpiece from Tószeg-Laposhálom is categorized by Hüttel as a disc cheekpiece of "Mycenaean décor". But its décor is the 'eye motif' that David (David 1997; 2007) does not recognize as any form of the SM. Putting aside the possible SM décor until below, because this piece is broken, as noted by Hüttel, it may also be a contamination form. This piece, along with another more plain example from Berettyóújfalu-Szilhalom (Dani 2012; Máthé 1988) have a higher likelihood being related to steppe type cheekpieces because the form is reminiscent of several of the contamination form finds from the steppes. Hüttel (1981:56–65) and Bochkarev and Kuznetsov (2013:73–75) document some

similarities of the steppe contamination cheekpieces with these four Danubian pieces. Beyond the idea that this possible hybrid cheekpiece probably indicates some contact of equestrians between the two bridle circles, it could be that these contamination forms represent the material correlates of a continued tradition of riding.

The bridle circle of the Carpathian Basin was a long-term, durable, and autochthonous development. If riding was present with domestication and early use of horses, then when horses arrived in Hungary in the EBA in large numbers, it follows that they were ridden. As cultural indications of the significance of horses shifts into the MBA, and horses appear to be an important species maintained into old age, they spread throughout Hungary as the Danubian bridle bit tradition flourishes throughout the region in all of the tell building cultures (Figure 6.20). The hunting of red deer and their presence as the most frequent wild animal on these settlements highlights the extensive use of antler in crafting both tools and bit cheekpieces. The increased availability of red deer antler may have played a role in the development of the bridling technology here, perhaps replaces other organic forms of cheekpieces or bits.

Surprisingly, the spread of bits and horses does not extend further east and north until the LBA, confirming the boundary indicated by the bridle circle during the earlier Bronze Age, before the decline of the tell cultures. By the LBA, all bits are rod forms everywhere when they are made of bronze and this extends into the Iron Age. Moreover, these are the bits of known riders. Bökönyi (1953:8) finds,

> *Quant aux mors de bronze de l'age halstattien, leur témoignage n'est pas moins eloquent: la plupart des mors de bronze étaient fabriqués sur le modèle des mors en bois de cerf, ainsi la manière du harnachement n'a pas subi des modifications notable.*
>
> As for bits of bronze of the Hallstatt period, the evidence is not less eloquent: most bits were fabricated like bits of antler, so the style of bridle did not suffer notable modifications.

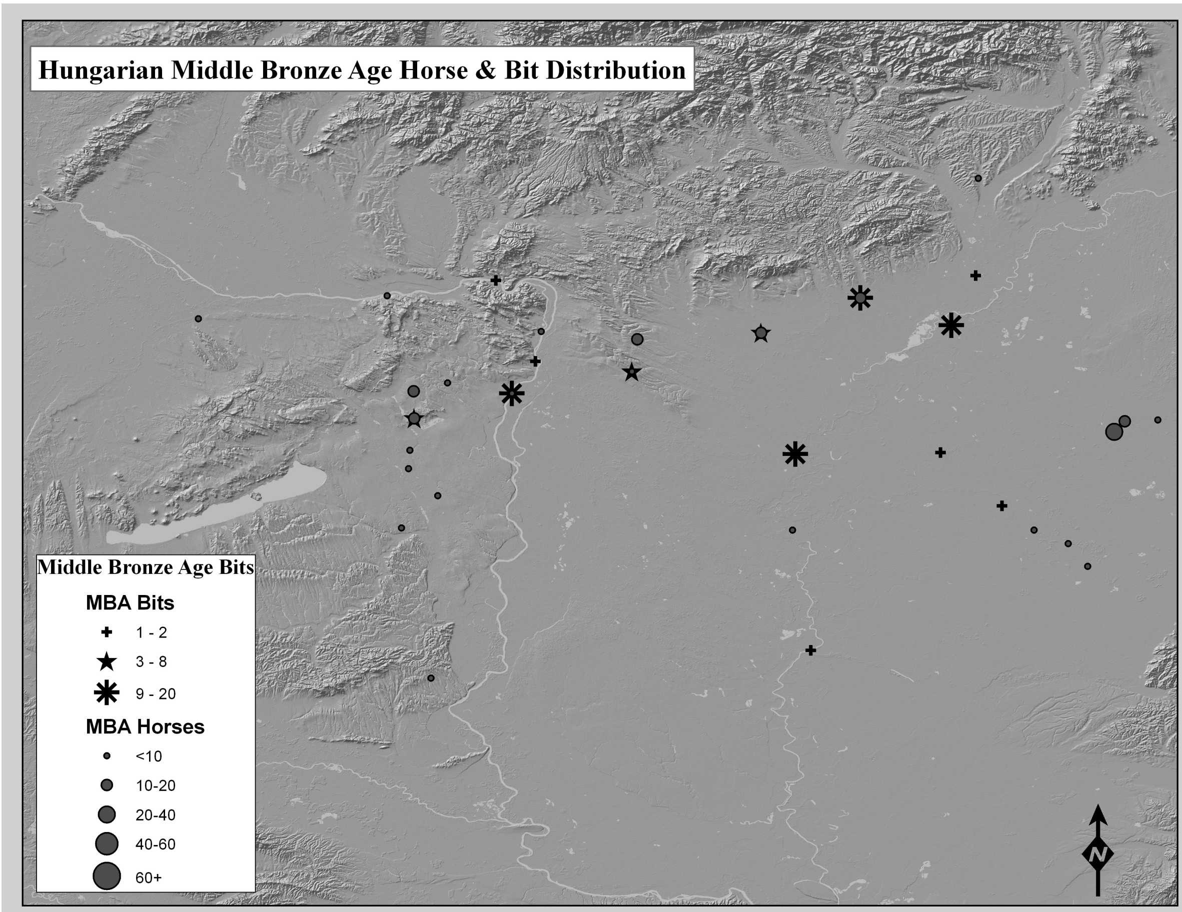

Figure 6.20. Horse in HRC and Cheekpiece Finds of the Hungarian MBA.

Important also to remember is that the first known battlefield of the Bronze Age found at the LBA (c. 1250 BC) site of Tollense in Germany, people died on horseback, not with chariots (Jantzen et al. 2011; Price et al. 2017), even though the use of the chariot in the urban cultures of the Near East and Egypt was in full swing. With these points in mind, I find that the rod shaped cheekpieces are most likely evidence of the bits of an equestrian tradition of riding, extended and further developed in the Hungarian Bronze Age that is largely independent of the emergence of

the chariots on the steppes. Contact is likely maintained at some level between these groups, but their specific bridling and bitting traditions are strongly use-based and culturally contingent.

Chariotry and the Don-Volga-Ural Bridle Circle

The Don-Volga-Ural Bridle Circle as defined by Hüttel (1981) consists primarily of disc shaped cheekpieces, with some rectangular cheekpieces, both associated with chariot use. Like the Carpathian Basin Bridle Circle, "Disk-shaped cheekpieces, usually interpreted as specialized chariot gear, also occur in the steppe graves of the Sintashta and Potapovka types dated by radiocarbon before 2000 BCE" (Anthony 2007:402). Originating in the steppes and then diffusing to other regions, after c. 1800 B.C. the chariot became widespread in the Near East, from Egypt to Anatolia (Anthony 2007; 2009; Feldman and Sauvage 2010; Kuznetsov 2006), though the steppe origin was previously contested (Littauer and Crouwel 1996; Moorey 1986). "Chariots were invented earliest in the steppes, where they were used in warfare. They were introduced to the Near East through Central Asia, with steppe horses and studded disk cheekpieces" (Anthony 2007:403). Chariots from their inception are irrefutably associated with disc shaped cheekpieces.

> At the turn of III-II millennium before Christ (the beginning of the Late Bronze Ages) in the northeastern zone of Eurasian steppes began to appear the burial complexes, in which were found light two-wheeled chariots, their components, harness and horse skeletons. The morphological characteristics of chariot horses under different archeological cultures are common and this fact is the evidence of the certain defined selection and common training skills. The main element of harness – shield cheek pieces have the common princips of making and fastening, which are determined with the certain defined rules of riding chariot harness (Bochkarev et al. 2010:346–347).

There is a very strong consensus that disc cheekpieces are used with chariots. Usachuk (2010) has an excellent review of these issues and of previous efforts to reconstruct Bronze Age bridles with disc cheekpieces. Brownrigg (2006), Chechushkov (2013), and Chechushkov,

Epimakhov, and Bersenev (2018) convincingly demonstrate with replicas of the Bronze Age cheekpieces used on modern horses that these bridles with disc-shaped studded cheekpieces are quite effective for driving. Chechushkov also rode with his bridle, which suggests they could be used for both purposes, though he and Hüttel (1981) find that these bits are an excessive design for riding. This design is beyond what would be needed for simply riding a horse, even into battle, but it is extremely effective when the aids the driver has are reduced solely to the reins, especially in turns. The studded disc cheekpiece was probably developed as a precision driving bit.

The Evidence for Chariots in the Hungarian Bronze Age

The idea of a 'chariot package' has been introduced previously and included in both World Systems Theory (WST) and the political economy model for the Hungarian Bronze Age and Bronze Age Eurasia (Earle and Kristiansen 2010; Earle et al. 2015; Kristiansen 2000; 2016; Kristiansen and Earle 2015; Kristiansen and Larsson 2005; Vandkilde 2014). This package is considered to be an import from the steppes or Mycenae at the beginning of the EBA in Hungary. It consisted of an influx of horses, chariots, chariot builders, and trainers with new weapons. Earle and Kristainsen (2010:20) assert that,

> The emergence of a more complex, stratified society penetrated all social spheres. A new aristocratic leadership emerged on top of the traditional clan-based organization of farmsteads and hamlets. It was sustained by a new political organization based upon elite warriors commanded by chieftains. With the introduction of the chariot, the composite bow, the long sword, and the lance, warfare took on a new social, economic, and ideological significance from the beginning of the second millennium BC. This was reflected, for instance, in burial rituals where chiefly barrows became a dominant feature of the cultural landscape. Master artisans came to build chariots, breed and train horses, and produce and train warriors in the use of new weapons. The packages of skills were so complicated, that it must have demanded, at first, the transfer of artisans, horses, and warriors. The warrior aristocracies and their attached specialists transformed Bronze Age societies throughout Eurasia and the Near East.

While disc (and rectangular) shaped studded cheekpieces are accepted as unequivocal evidence of chariotry in the steppes, these styles were not present in the Carpathian Basin. Nor was the chariot. No chariots, chariot parts, or any direct evidence of horses associated with wheeled vehicles have been found in the Carpathian Basin until the very end of the LBA, after 1050 BC, and especially during the Hallstatt Period in the EIA, 810/800-480 BC (Dular 2007; Kmeťová 2013b; 2013a; 2017; Kmeťová and Stegmann-Rajtár 2014; Metzner-Nebelsick 2002; Pare 2004). The bronze chariot wheels from Obisovce (Eastern Slovakia) and Arcalie (Transylvania), formerly thought to date to the MBA, are now dated to be LBA Urnfield (Pare 1992:19–21; Winghart 1993:Figure 1), shown in Kristiansen and Larsson (2005:222, Figure 22).

If there was a chariot package, where are the associated finds that occurred with chariot burials on the steppes? Besides a lack of studded disk cheekpieces, missing are any of the arrowheads or spearheads that were the new and most numerous weapons in chariot burials. There is no other material evidence, such as pottery, tools or the radically different settlement building traditions of the chariot peoples of the steppes, to indicate an influx of foreign artisans/warriors/riders or horses at the beginning of the MBA.

The chariot is also a vehicle wholly unsuited for the terrain of the Carpathian Basin. The chariot is designed for use on dry, flat, prepared land if it is to be used in battle (Jones-Bley 2006; Littauer and Crouwel 1979). The idea that the chariot is a 'speedy' vehicle for warriors to race to battle, fight in, or merchants to traverse the rugged landscapes in long-distance trade is hard to sustain. There is no evidence for the formally prepared roads that would be required for chariots. It would be incredibly easy for a mounted rider to out maneuver and out fight any charioteer in the hilly terrains surrounding the river valleys where the tell settlements were located. If even 'simple

roads' were maintained, a rider could force a chariot off the roads and into un-traversable terrain. Although pictured as the exemplar of the warrior elite of the tell at Százhalombatta-Földvár, even illustrated on the cover of Earle and Kristainsen (2010), any chariot of the period would have an incredibly difficult time even making it up to the settlement, given the grade of the terrain, and the open-back construction the chariot.

> Although we have records of great chariot battles, where these battles took place had to be selected with care in order to have space for the chariots to maneuver and the ground had to be reasonably flat (Littauer and Crouwel 1979:92). While much of Anatolia would be unsuitable for chariot warfare (Macqueen 1986:59), much of Egypt and the Near East would qualify. Another factor rarely mentioned are roads…Roadways in areas outside the Near East are very problematic. Trackways are known from England, Ireland, and Germany but they are narrow and would hardly have serviced a wheeled vehicle. Wheeled vehicles require more than a path used by pedestrians that in a wet climate would often become impassable except on foot. Egypt and Mesopotamia have much drier climates with flat, less encumbered terrain more suitable for wheeled transport. Moreover, these very complex societies had extensive trade routes that were in constant use (Jones-Bley 2000:138).

Also lacking is any evidence of the kurgan type mortuary practices that were central to the emergence of the chariot on the steppes. There were no 'chiefly barrows' or 'princely graves' in the Hungarian Bronze Age, which would be expected if there was an aristocratic warrior elite. These are present in the MBA Únětice Culture north and west of the Carpathian Basin, the LBA Tumulus people of the west, and the Scandinavian EBA (Hungarian MBA/LBA), none of which have any horse bone or bit finds or wheeled vehicles associated with them. This is another unfortunate conflation of regions, finds, and chronologies.

Recent study of the steppe chariot burials also refutes the idea of an exclusive male elite chariot warrior class, dominating all of the steppe chariot cultures. There were women and children found with chariot cheekpieces.

> Archaeologically, we do not see a social group of so-called 'warrior-charioteers' who were exclusively occupied in war or training for it. By comparison, conflict, and the need for defensive structures during the Bronze Age in Europe and the Ural steppe differed dramatically, depending on fundamental environmental, economic, and social differences (Kupriyanova et al. 2017:40).

Even though the Iron Age barrows, like that at Százhalombatta-Földvár, have large barrows with men buried with horse bones and bits with boar tusk cheekpieces, this EIA phenomena is not the domain of solely elite male warriors, women have bits and horses buried with them too (Kmeťová 2013b; 2013a; Kmeťová and Stegmann-Rajtár 2014).

The Spiral Motif and Contacts of the European Bronze Age

In the past, the SM was considered to be clear evidence of the impact of the Mycenaean world upon the rest of Europe. The SM, SM decorated cheekpieces, and the now-outdated relative chronologies partly based on them, were used to highlight a core/periphery or World System Theory or "Bronzization" models of the development of the tell cultures of Hungary (Earle and Kristiansen 2010; Kristiansen 1994; 1999; 2000; 2007; 2012; 2016; Kristiansen and Earle 2015; Kristiansen and Larsson 2005; Thrane 1999; Treherne 1995; Vandkilde 2011; 2014; 2016). These Pan-European narratives have been rightly and roundly criticized in recent literature (Brück and Fontijn 2002; Frieman et al. 2017; Kienlin 2012; 2015; 2017). Now it has been recognized that incorporation of the SM was introduced to Mycenae from the north, originating perhaps in the Carpathian Basin, Steppes, or Anatolia (Fischl et al. 2013; Kiss 2012a) Maran and van de Moortel (2014:545) explain:

> It is ironic that for a long time the influence of the Shaft Grave phenomenon was claimed to have served as a "civilizing" impulse provoking change in regions to the north of Greece, while we now realize that the origin of Mycenaean culture was decisively based

> on the appropriation of foreign cultural forms, some of which originated in those very regions of central, southeastern, and eastern Europe.

The media decorated with the SM differs from region to region. While the SM appears on gold, glass paste, and stone in the Aegean, it occurs on antler, bone, and bronze in the Carpathian Basin (David 2007). Also in contrast, the SM occurs on finds from many settlements in Hungary, over a long time period, while only found in mortuary contexts from three sites, in seven tholoi and shaft graves (David 1997). While the SM is similar in its form, the media and contexts are dissimilar. That the SM demonstrates cultural contact is highly probable; that it demonstrates the dissemination of the chariot and a Pan-European elite ethos is not.

Four objects (not an 'abundance of warrior-chariot gear') that are probably disc cheekpieces for chariot horses, widely and inaccurately reported to be decorated with the SM, were found in Shaftgrave IV at Mycenae. David (1997; 2002; 2007) did not include these cheekpieces in his assessment of the SM and as evidence of contacts between the Carpathian Basin and the Aegean. This was probably because, upon closer inspection, the décor of these pieces resembles the edge designs from the disc and rectangular cheekpieces of the steppes (Figure 6.21). Though smaller, they are disc shaped and spiked, and morphologically similar to the steppe chariot pieces.

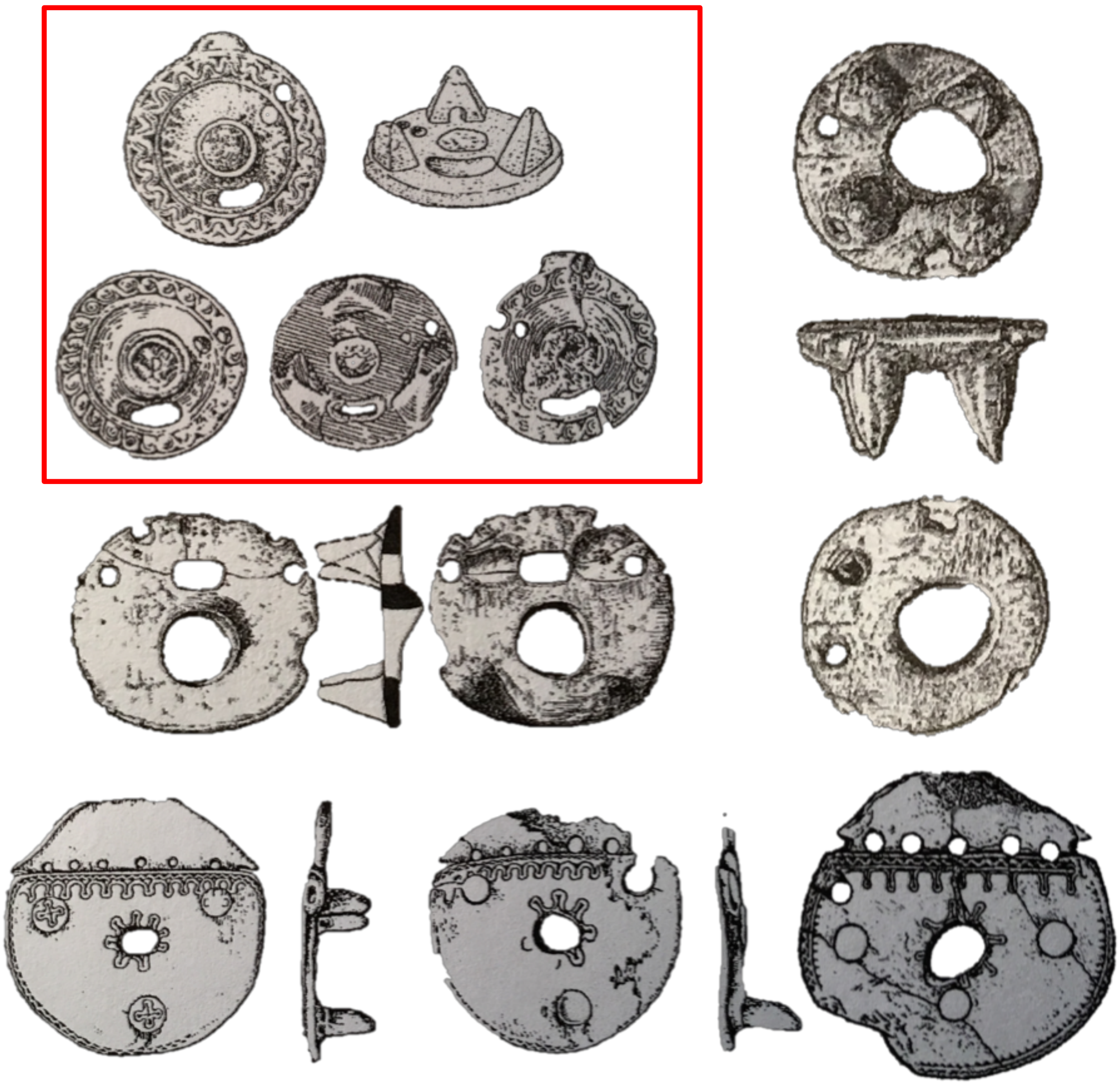

Figure 6.21. Comparison between the Mycenae Cheekpieces and Steppe Cheekpieces (after Bochkarev and Kuznetsov 2013). Pieces Boxed in the Upper Left are from Mycenae.

The probable chariot cheekpieces of Mycenae are not like any cheekpieces from the Carpathian Basin. They likely represent a steppe influence and chariot introduction, also documented genetically (Lazaridis et al. 2017). The only certain find that has any relationship with the rod shaped cheekpieces of the Hungarian Bronze Age is the find of a modified hybrid disc and serrated plate rod antler bit from a destruction layer from final Late Helladic destruction level at

Mitrou in central Greece. This piece probably dates to around 1550-1500 BC, and is viewed as an appropriation of central, southeastern, and eastern European forms (Maran and Moortel 2014). It is decorated with the SM. No other objects decorated with the SM in Mycenae are associated with horses or chariots at all. Cunliffe (2008:224–225) finds,

> It has long been recognized that there were a number of marked cultural similarities between the Mycenaean culture and that of the inhabitants of the Carpathian Basin – not only in the use of the spoked wheel but also in curvilinear styles of decoration applied to bonework and other kinds of horse gear. This used to be interpreted as a result of Mycenaean influence spreading north, but with the advent of radiocarbon dating it has become clear that these cultural elements had emerged in the Carpathian Basin centuries before they are found in Greece.

Much of the desire to place the Carpathian Basin as a receiver and intermediary of Mycenae is because of the view that it links Scandinavia with the Aegean. One pair of SM decorated antler cheekpieces was recovered in Denmark at Østrup, which likely date to the Hungarian LBA (Hüttel 1981:103). Chariots are also widely depicted on Scandinavian Rock art. There are also many finds of weapons that were later, local copies of MBA Central European types. These lines of evidence have been used to place the Carpathian Basin and MBA Hungary as the mediators in long-distance trade and the dissemination of the 'international' elite culture to Scandinavia (Kristiansen 1987; 1994; 2000c; Kristiansen and Larsson 2005; Earle and Kristiansen 2010). "Weaponry, horse gear, and other items belonging to the warrior may constitute the upper hierarchy of transmitted transculture" (Vandkilde 2014:614).

The chariots that were thought to spread to Scandinavia through Central Europe only appear in Scandanavian rock art from *after* 1500 BC (the end or very end of the Koszider period), and their appearance was more probably connected with the Atlantic route of ore acquisition and the Amber trade to the Mediterranean (Ling and Uhnér 2014:28). "Several scholars have stressed

that Scandinavia was connected to the Mediterranean world via Central Europe during the Bronze Age and this route was indeed highly important (Thrane 1975; 1990; Kristiansen and Larsson 2005). However, the material, not least the isotopic evidence, points to a more complex picture with a stress on an alternative western 'maritime' route" (Rowlands and Ling 2013:522). Moreover,

> Turning back to the supply of copper to Scandinavia, about 1500 BC and onwards it appears that copper exchange networks along the Atlantic seaboard occupied a dominant position. Nordic bronze swords and other Middle Bronze Age (1500 – 1100 BC) artefacts share isotopic signatures with British swords, which in turn are consistent with copper ores from the western Mediterranean (Ling and Uhnér 2014:30).

Also problematic is the use of socketed spearheads from the Seima-Turbino metalwork complex originating in the steppes, as evidence for a c. 1700 BC Carpathian mediated influence in Scandinavia, as ultimately drawn from the Aegean. Vandkilde (2014:609–610) finds that both the casting technology and designs demonstrate the earliest contacts between the Carpathian Basin and Scandinavia after 1700 BC. Also suggested is that the simple geometric designs on these items became the SM which connected Mycenae to the Carpathian Basin, the steppes and southern Scandinavia. However,

> Similarities between the Seima-Turbino socketed spearheads and daggers and parallel objects in Mycenaean tombs were once used to date the Seima-Turbino horizon to a period after 1650 BCE. It is clear now, however, that Mycenaean socketed spearheads, like studded disk cheepieces, were derived from the east and not the other way around. Seima-Turbino and Sintashta were partly contemporary, so Seima-Turbino probably began before 1900 BCE (Anthony 2007:447).

MBA Hungary has been used in an attempt to link the changes that occurred in Scandinavia centuries later with Mycenae. What can be shown is the use of the SM at a regular, but relatively low, level of décor on the EBA and MBA Hungarian bits that best date from 2000/1900-1700/1600 BC. The SM appears on *one* locally made hybrid cheekpiece in the Aegean and *one* set of LBA

rod-shaped cheekpieces from Denmark. It also appears on other finds in mortuary contexts of LH Mycenae. While I have not examined the weapons with motifs perhaps similar to the SM, the Hajdúsámson-Apa horizon, these also date from 1800-1600 BC. The Late Helladic I Period dates from 1650-1500 BC. In all probability, the SM grew from the Carpathian Basin outward, at different rates, and was incorporated locally in culturally mediated ways. While the SM suggests cultural contact, it is not substantiated that it had something to do with a Pan-European elite chariot warrior. Fischl et al. (2013:364) explain that, "most of the previously so emphatic »Mycenaean connection« proves to be a myth due to both chronology (Raczky et al. 1992) and the lack of convincing material evidence".

Summary of Thinking About and Using Horses in the Hungarian Bronze Age

First, there was a change in the cultural significance people placed on horses from the EBA to the MBA of Hungary. As equine demography and geography shifted at settlements throughout the region so did the body part representations, particularly at the Vatya settlements, which illustrate that horses were treated differently from other livestock. Meat acquisition from horses likely was not a primary goal of carcass utilization by the MBA and later in most areas of Hungary. Burial of skulls and a horse skeleton, and perhaps head and hoof elements for specialized deposits, support this assertion. Robb (2013:663) finds, "Animals are probably the best example of new things being accepted by new ways of thinking". Horses did increase in importance as their use became more exclusively tied to riding as they dispersed throughout the region in the MBA.

Absolute chronologies and the bit finds underscore the unique origins and position of equestrianism in Bronze Age Hungary. The durable and persistent differences in bridling

technologies evidenced by the rod versus disc bridle circles illustrate significant differences in horse usage, along with indigenous developments in equestrian technologies in each region. We can probably safely assume that riding accompanied domestication and domesticated horses into Hungary in large numbers in the EBA. Riding in Hungary continued and became associated with the rod cheekpieces while chariotry was associated with disc cheekpieces, that may have been used for both chariotry and riding, or they continued to ride with organic bridles. Rod cheekpieces in bronze bits of the Iron Age replace disc cheekpieces everywhere as organized cavalry emerges and chariots fall out of use, save in sporting competitions. The rod cheekpiece in this bit form, so clearly associated with riding in the Iron Age and beyond, first is associated with riding in the Hungarian Bronze Age.

Horse bit cheekpieces are never found with weapons or in graves in EBA or MBA Hungary. Weapons are rarely found in graves in the Hungarian Bronze Age. The chariot originated in and spread from the steppes. The weapons associated with chariots in the steppes do not arrive together as a package, as the new type flint points for javelins and arrows that occur with the early chariot burials are entirely missing from the Carpathian Basin. Daggers are the predominant weapons in the small number of graves in Hungary that had weapons, followed by axes. The famous Hajdusamson-Apa type swords are only ever found in hoards, not graves. If the chariot arrived as a package with master artisans to “build chariots, breed and train horses, and produce and train warriors in the use of new weapons” (Earle and Kristiansen 2010:20), where are the material correlates for this massive influx that are also chronologically and contextually related? Unlike in the steppes, there are no chariot burials. There is also no other material evidence, such as foreign

pottery styles, etc., for the influx of a class of foreigners, who are hypothesized to bring the very idea of the warrior aristocracies to Hungary.

There are no connections of horses to wheeled vehicles until the terminal LBA into the Iron Age, and these were predominately four-wheeled wagons in Hungary. Although Earle and Kristiansen (2010:233) suggest that chariots wouldn't be recovered archaeologically, this is a convenient assumption to explain away the absence of chariot related evidence from the Hungarian MBA. Artifacts associated with wheeled vehicles are frequently recovered in the LBA and Iron Age (Pare 2004). Quite a number of chariot burials with clearly outlined wheels are found on the steppes. Other regions where chariots were present also have artifacts found that directly related to the vehicle (Feldman and Sauvage 2010).

The idea that chariotry associated with warrior aristocracies disseminated from Mycenae through Hungary to Scandinavia, is chronologically and materially incorrect. Chariots appear on Scandinavian rock art after 1500 BC, likely the result of an Atlantic trade route, not a Central European one. This is at the very end of the MBA Koszider period in Hungary. If this rock art is purportedly reflective of the development of a Pan-European chariot warrior elite, and if it is to be used to substantiate the role of chariotry in the emergence of centralized polities in the Hungarian Bronze Age, it is late by four or five centuries. Furthermore, Kiss (2012a:226) finds that,

> Long-distance trade between the cultures of this Bronze Age period and the Aegean is generally assumed, whereby raw materials (amber, Transylvanian copper and gold) reached the Mycenaean world in exchange for swords and a diverse range of other goods, as well as various technical innovations (e.g. stone architecture, spiral motif). However, the radiocarbon dates for the Bronze Age cultures of the Carpathian Basin and Central Europe indicate that the developed phase of the Early Bronze Age cultures of Central Europe (corresponding to the Middle Bronze Age of the Carpathian Basin, RB A2: 2000/1900–1600/1500 BC) began earlier than the Mycenaean period and that the end of their *floruit* overlapped but briefly with the start of Mycenaean civilisation (LH I: *ca*. 1600–1500 BC).

Although the SM does potentially indicate *some* indirect or direct contact between Mycenae and Hungary at the end of the Hungarian MBA, what that connection is, beyond the adoption of a similar decorative motif on a minority of cheekpieces and weapons, is not clear. The direction of that connection is not known either. However, given the very probable earlier presence of cheekpieces with the SM in Hungary during the MBA, the possibility of this motif originating in Hungary, along with the autochthonous development of specific bridling technology indicated by the rod cheekpieces, is great.

There are a number of possible reasons why riding persisted and chariotry was resisted in the Carpathian Basin, while chariotry developed on the steppes and spread to Bronze Age states. The cultural and geographical context within which chariotry emerged on the steppes was quite different than that of the Carpathian Basin.

> Taken together, evidence from fortifications, weapon types, and numbers, and the tactical innovation of chariot warfare, all indicate that conflict increased in both scale and intensity in the northern steppes during the early Sintashta period, after about 2100 BCE. It is also apparent that chariots played an important role in this new kind of conflict (Anthony 2007:405).

Another possibility for the lack of demonstrable chariotry and conflict in the Carpathian Basin is that chariotry and chariot burials emerged as a way for the long riding, deep equestrians of the Pontic Caspian steppes to "define membership in the elite and to channel political competition within clear boundaries that excluded most people" (Anthony 2007:405) in *tournaments of value*, after Appadurai (1986). That the chariot is associated with status and prestige is widely accepted because of the great expense and technology associated with it. Many authors have suggested that its use as a mode of distinctive and prestigious transport may have

been of greater importance for its spread than its use in warfare in many places, review in (Feldman and Sauvage 2010).

The same time in Hungary, the EBA to MBA transition was not a period of increased conflict. There were probably a small number of horses were ridden by people to herd and protect livestock. I suggest that mounted warfare, and the specific types of weapons developed here, grew out of the practices of herders, protecting livestock and their pastures, which may have extended into mounted warfare. Evidence of warfare and violence and burials of potential warriors is significantly underrepresented in the Hungarian Bronze Age. Ubelaker et al. report (2006:254) a rate of 4% of skeletons bearing any trauma for the Hungarian Bronze Age, and that this trauma is more consistent with accidents (my bioarchaeological analysis is the same in Chapter 8).

> It is usually assumed in the literature that the Bronze Age in Hungary is characterized by the emergence of a warrior aristocracy, who were the political leaders of their communities (Earle and Kristiansen 2010; Kristiansen 2000). While there are many indications for this, the evidence for warfare in Middle Bronze Age Hungary is not overwhelming, although the various sources of evidence for warfare and violence have not been studied in sufficient detail. According to our current knowledge, there are relatively few warrior graves from the Early and Middle Bronze Age, and weapons mostly come from ritual hoards. They are richly decorated and seem to be to have been mostly ceremonial weapons. Very few use-wear analyses have been carried out yet, and the ones available provide evidence for both ceremonial use and use as a weapon. The analysis of skeletal remains has recently gained momentum, but there are still many unpublished results, and in many cases the skeletal remains from older excavations are lost or cannot be connected properly to graves. What we can establish so far is that the ratio of bodies showing physical trauma is rather low. The ‘mass graves’ presented here can probably be connected to sacrifice and ritual violence, and not warfare (Szeverényi and Kiss 2018:49).

Therefore, the association of the chariot with a warrior elite in the theorized development of centralized polities, the political economy and institutionalized social stratification during the MBA is unsubstantiated. There were no chariot riding warrior elite in the Hungarian Bronze Age.

CHAPTER 7

Political Pathologies:
Osteopathologies of the Horses of the Hungarian Bronze Age

Because of the mutually physical relationships of people and horses when riding or driving, impacts of these relationships may be recorded in the skeletal remains of each species. Movements of horse and rider influence and affect each other, which is a complex coupled system (Peham et al. 2004). The frequency and type of use, environment, tack and equipment, and training of horse and rider or driver also affect the interaction and the severity of musculoskeletal stress each individual sustains that can result in osseous pathologies of the skeleton. Conformation, age, and condition also significantly influence what may be recorded on bone. Neither human nor horse initially evolved particularly for equestrian pursuits, so impacts of this interaction are likely to be visible osteologically on each species. Levine et al. (2005:81) find,

> The basic premise underpinning the palaeopathological approach is that the horse did not evolve in nature to carry a person on its back or to pull chariots and wagons…the stresses associated with riding and traction differ from those related to more natural activities. Furthermore, because the stresses connected with riding differ from those connected with traction, we would expect that if horses were used primarily for one or the other, this would also be reflected in their bones.

This is similarly true for humans.

In this chapter, I establish that the horse teeth and bones have pathologies that are more consistent with riding that driving. I analyzed the bones of horses from the Bronze Age of Hungary for osteopathologies that may be related to riding and draught. I drew on archaeological, veterinary, and medical research into the common consequences of riding and driving that may be visible archaeologically. I examined two main areas for signatures of horse use in the horse bones from Bronze Age Hungary: 1) dental / cranial; and the 2) postcranial skeleton. Figure 7.1 illustrates

the entire skeleton of the horse. Figures 7.2 and 7.3 show the crania, mandible, and teeth of the horse in greater detail. If horses were used for riding or draught more extensively in the Hungarian Bronze Age, osteopathologies should be evident in their teeth and bones. There should also be an increase in horse osteopathologies from the EBA to the LBA and lesions should be related to work in some cases.

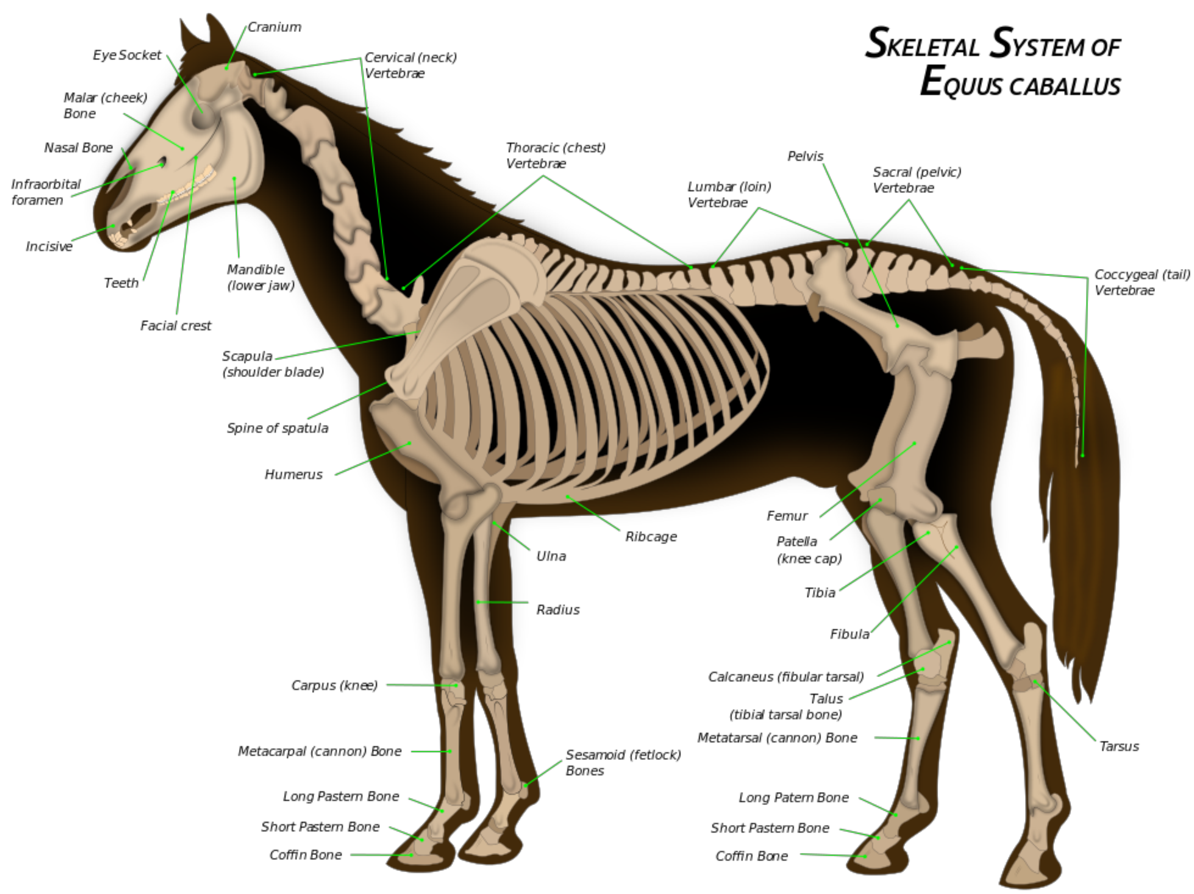

Figure 7.1. Skeleton of the Horse (Wikimedia Commons contributors 2017).

Dental and Cranial Bit and Bridle Pathologies of Horses

The longest, best studied, and most unduly contentious evidence for horse use comes from pathologies evident from the bit and bridle. Anthony and Brown (2011:146) find, "Direct archaeological evidence for riding has been elusive. The best evidence would be a pathology in horse bones or teeth associated strongly with riding. The most promising riding-related pathology is wear on the premolar teeth and mandible caused by a bit". Bökyönyi (1972), Clutton-Brock (1974), and Azzaroli (1985) noticed unusual beveling on the lower premolars (LP2s in horses) of horses recovered from archaeological contexts of Bronze and Iron Age horses, and suggested that this wear came from bits. Clayton and Lee (1984) and Clayton (1985) documented the position of bits in living horses' mouths fluoroscopically and recorded them regularly gripping bits with their LP2s, which can result in wear on these teeth caused by the bit (Figure 7.2). The LPs are indicated with arrows in Figures 7.2, 7.4, and 7.5 below.

Figure 7.2. Fluoroscopic Side View of a Snaffle Bit in Horse's Mouth (Clayton and Lee 1984).

The bit is fitted to rest on the sensitive bars of the mouth, also known as the diastema or mandibular interdental space. Figures 7.3, 7.4, and 7.5 below illustrate the areas of the crania and teeth affected by bits discussed here. Horses often try to alleviate the painful pressure of the bit when the rider uses the reins by variously ‘giving to the bit’ by breaking their poll (top of the head, marked by an arrow in Figure 7.3) and tucking their chin, by taking the bit between the teeth, or by lolling the bit around the mouth between the bars and teeth (Manfredi, Clayton, and Rosenstein 2005). As horses are individuals, some do none or all of these things. Variations in conformation and disposition can affect the incidence of these behaviors and the resultant abnormalities in the teeth and mandibles. Horses, for the most part, naturally prefer one side over the other, like handedness in humans (Meij and Meij 1980; Murphy et al. 2005). Both preferences in humans and horses can affect if one or both sides of the teeth and mandibles obtain wear. The skill of the rider is at play as well, so that affects the response of the horse, as is the degree and quality to which the horse is trained. This variation should be kept in mind when evaluating archaeological horse teeth, especially when considered with the wide variation of bit types and bridling traditions of prehistory.

Figure 7.3. Horse Crania and Upper (Maxiallary) Teeth. The Incisors (Arrow 1), Upper Premolar (UP2) (Arrow 2), and Poll (Arrow 3). Crania from Immature Horse with Supranumerary First Premolar (Wolf Tooth), Not Normally Present.

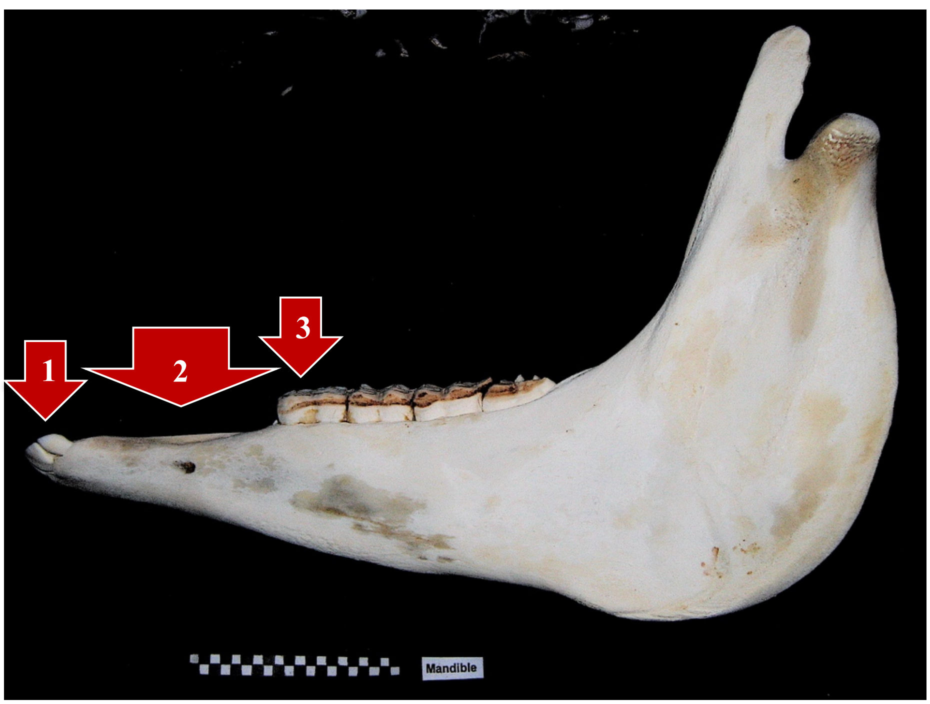

Figure 7.4. Horse Mandible and Lower (Mandibular) Teeth. The Incisors (Arrow 1), Bars (Arrow 2), and Lower Premolars (LP2s) (Arrow 3). Crania from Immature Horse, Teeth Still Erupting.

Figure 7.5. Horse Mandible, Dorsal View. Incisors (Arrow 1), Lower Second Premolars Bars (Diastema) (Arrow 2), and (LP2s) (Arrow 3) (Mandible from Immature Horse, Teeth Still Erupting).

Methods for Identifying Bit and Bridle Wear on Horse Teeth and Crania

Anthony and Brown (1989) first documented the effect of bits on LP2s as "bit-wear" through *bevel* measurements for mature domestic and feral horses. Anthony and Brown (1989; 1991) devised a reliable and ethnoarchaeologically tested method of identifying such bit-wear in modern horses by conducting experiments on previously never-bitted, ridden, or driven horses with organic and bone bits (Figure 7.6). They compared the results with both modern horses ridden with metal bits, archaeologically recovered teeth, and modern feral horses (mustangs). Horses that had been bitted daily had larger bevels than those less frequently or rarely bitted. This bevel is visible macroscopically. Microscopically, this effect is visible on the occlusal surface, but only with hard bits of metal or bone.

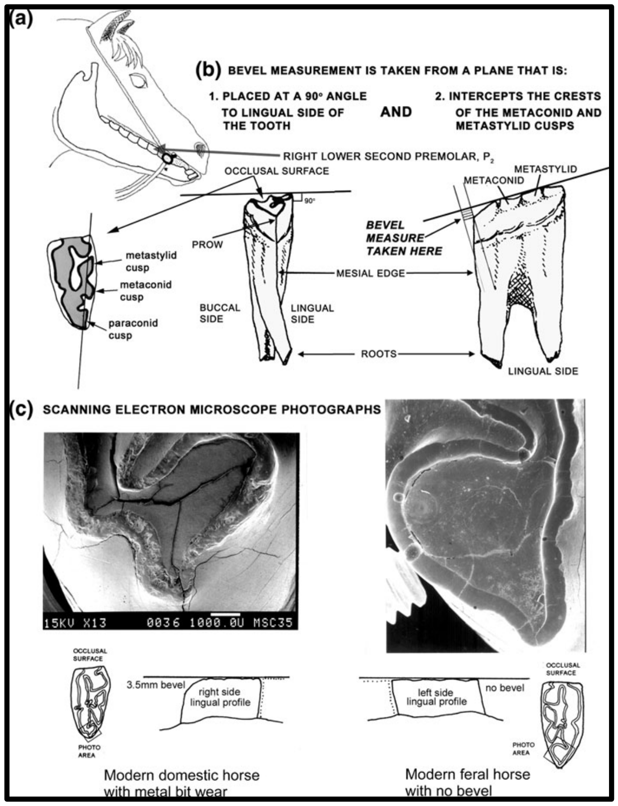

Figure 7.6. Type 1 Bit-wear Methodology to Identify Bevels (a, b) and Microscopic Wear (c) (Anthony and Brown 2011:147, Figure 10).

Criticisms of the diagnostic value of this method suggested that bit wear was unreliable for identifying archaeologically bitted horses because never-bitted or wild horses may have bevels resulting from malocclusion (Bendrey 2007a; 2007b; Benecke and von den Driesch 2003; Levine 1999c; 1999a; 2004; Olsen 2003; 2006). While this is can be true, critics either provided limited anecdotal evidence of observing such pathologies in wild horses or used problematic comparison samples of modern equids. Moreover, malocclusion has not been explicitly defined, nor was the incidence that bevel type wear from malocclusion occurs in never-bitted or wild equids. The most common malocclusion that would result in bevel bit wear are from focal overgrowths, also known as rostral hooks, on the maxiallary or upper premolars (UP2s), and the incidence varies

considerably in modern horses (Maslauskas et al. 2008). So called “parrot-mouth”, overbite in horses, can be a cause of rostral hooks or more commonly it may be the horse’s diet, conformation, use, or management. These hooks are more common in stable kept horses or captive kept equids that do not graze freely as was the most likely practice in prehistory. They are also more common in equid crosses such as mules, in Przewalski horses that are zoo kept, and in very old animals (>20 years). Bendrey (2007c) suggested that bevel bit-wear only be considered with the UP2s are present archaeologically, a steep task, as most archaeological horse teeth are recovered singly, especially in the Bronze Age.

Bevels may be caused by wear other than from bits, but bits also may cause them, so they are still a very important, and *potentially cultural*, indicator to identify. Anthony and Brown (2011) and Anthony et al. (2006) have archeologically tested, re-tested, and refined their methods and increased the criteria diagnostic for bitting. The occurrence of bevels following their revised criteria is exceedingly rare in a wild population, >1 % (Anthony et al. 2006:141). Discarding the method completely is premature. Continued recording of such pathologies on all specimens is valuable for the study of the osteological indicators of horse use. Using it in context of several additional methodologies for examining bit and bridle wear is also essential. We should use all possible methodologies at hand.

After Cook et al. (2003), Anthony and Brown (2011:146–152) defined three types of such pathologies that may be visible archaeologically. Bendrey (2007a; 2008) and Taylor et al. (2015) have devised useful additional methods for discerning possible pathologies of the mandible and crania resulting from bits and bridles. Five types of pathologies of the teeth, mandible, and skull

are considered here. All of these methods were utilized where possible when evaluating the horses of Bronze Age Hungary.

Type 1 (shown above in Figure 7.6, a) is a wear facet or bevel created by the horse grasping the bit between the tips of its premolar teeth (Anthony et al. 2006). This causes the bit to slip back and forth over the front or mesial corner of the occlusal surface of the P2, or lower second premolar, which is manifested in a beval of 3 mm or more on the occlusal surface of an adult horse (>3yrs). The measurements are taken by placing ruler across 2nd and 3rd lingual cusps to that the ruler forms a right angle with the lingual side of the tooth. Calipers are then used to measure the distance between the bottom of the ruler and the point on the tooth at which the occlusal surface meets the measial edge, round to nearest 0.5 mm. The criteria for macroscopic bit wear is an angled facet or bevel of at least 3 mm on the mesial corner of the LP2, and horses must be > 3yrs. Microscopically, scars should be visible on the occlusal enamel, visible at 10-15x magnification, but only hard bits will leave such evidence.

Type 2 bit wear (Figure 7.7) is anterior enamel/dentine exposure (Bendrey 2007a). This is an abrasion on the leading or mesial vertical edge of the LP2, created by the rider pulling the bit back against the LP2, manifested in a narrow vertical patch of abraded enamel on the vertical prow of the tooth. Measurements are of the enamel/dentine exposure are of the height (EDH) measured from the anterior occlusal corner towards the root/mandible; and width (EDW) at the widest point (not measured within 5 mm of the occlusal corner) (Bendrey 2007a:1037). Criteria are that the EDH > 5 mm; anterior exposure must not be similar to, or less than, any exposure on the lingual or buccal sides; and the form of the exposure should be an approximately parallel-sided band.

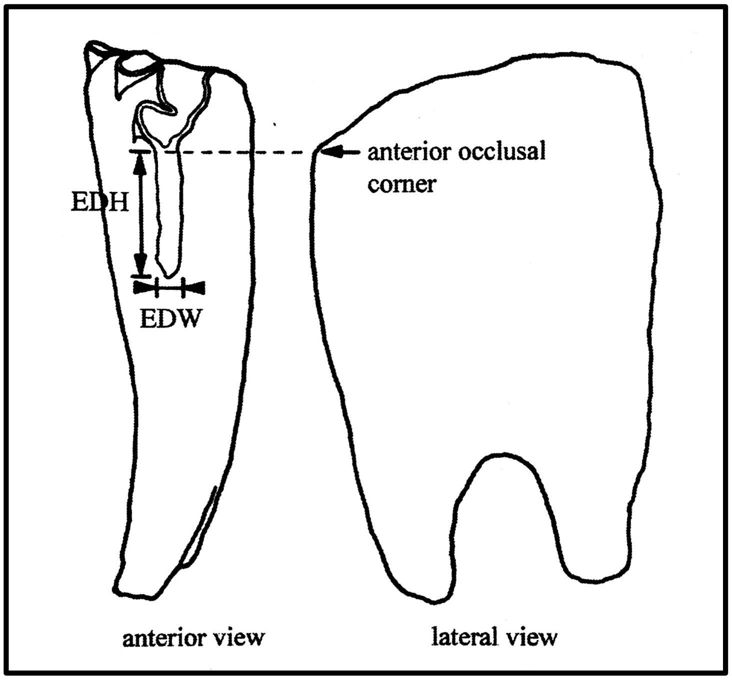

Figure 7.7. Type 2 Bit-wear Methodology (Bendrey 2007:1042, Figure 4).

Type 3 (Bendrey 2007a:1033–1044) (Figure 7.8) is remodeling or new formation of bone, bone spurs, or bone loss on the diastema of the mandible caused by inflammation of the gums in locations wounded by the bit. This is scored from (0) with no discernable changes to the diastema to (4) with pronounced or markedly flared continuous changes and bony projections > 5 mm. Bone loss to the diastema is also recorded from (0) with no changes to (++) with pronounced bone loss, viewed laterally at > ¼ the height of the diastema.

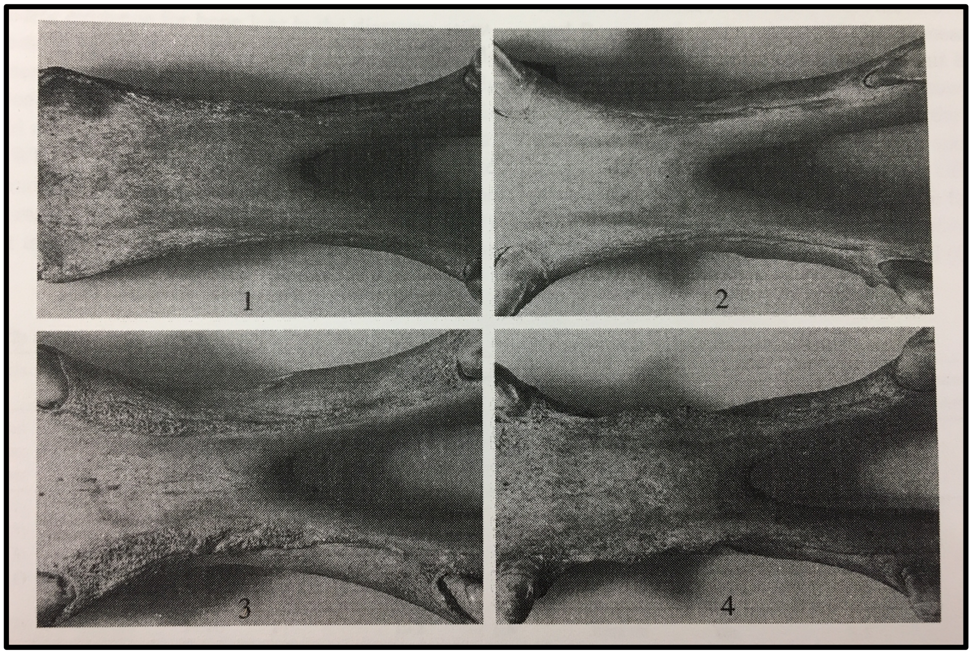

Figure 7.8. Type 3 Bit-wear Methodology (Bendrey 2007a:1044, Figure 7).

Type 4 (Figure 7.9) wear is new bone formation at the site of the nuchal ligament attachment of the skull, enthesopathy, which is more common in modern riding and driving horses (Bendrey 2008a:28). The location of this development varies in the less pronounced stages noted (scores 1-3) which have been recorded as locations A, the central portion of the posterior wall of the occipital bone between the external occipital protuberance and the nuchal crest, and B, the area of the external occipital protuberance. For the less pronounced stages the two areas are scored separately from (0) absent, no discernable development to (3) palpable bony (hypertrophic) projection. The more pronounced stages (scores 4-6) are manifested as a hypertrophy of bone that covers both areas A and B these are awarded one score for the combined area from a (4) bony (hypertrophic) projection, of less than 0.75 cm in length, that covers A&B to (6) bony (hypertrophic) projection, of more than 1.5 cm in length, that covers A&B.

Figure 7.9. Type 4 Bridle-Wear Methodology (Bendrey 2008b:27, Figure 2).

Type 5 (Figure 7.10) wear are medial and lateral grooves on the nasal process of the incisive bone caused by nosebands from tightened halters or bridles or from the cheekpieces of bridles (Taylor et al. 2015:860). The maximum depth of medial and lateral nasal grooves from the point of deepest groove formation, with straight line drawn along the plane of the nasal process of the incisive bone at the point of intersection between the groove wall and the arc of the bone's dorsal surface.

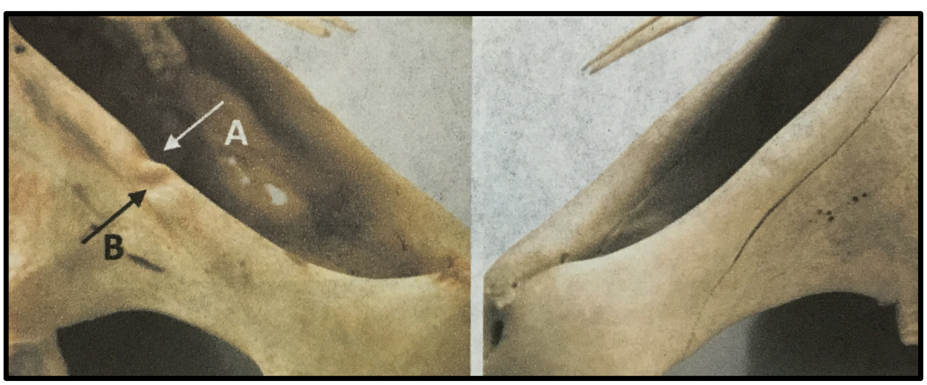

Figure 7.10. Type 5 Halter/Bridle Wear Methodology. Unworn Incisive Bone on Right. (Taylor et al. 2015:859, Figure 3).

Analysis of Horse Teeth and Crania from Bronze Age Hungary

There were 11 measurable teeth and mandibles MBA Hungarian sites from Vatya Királyok Útja 293 (n=7) and Százhalombatta-Földvár (n=3) and Gyulavársand Gáborján-Csapszékpart (n=1). Anthony and Brown (2011:153–154, Table 1) report an additional 18 teeth from six Hungarian LCA, EBA, and MBA settlements: Szigetcsép-Tangazdaság (LCA Baden-Pécel or EBA Bell Beaker, N=1); Csepel-Hollandi-Út (EBA Bell Beaker, N=3); Tószeg-Laposhálom (EBA Nagyrév, N=2; MBA Füzesabony, N=1); Feudvar- Mošorin (MBA Vatin, N=10); and Békés-Városerdő (MBA Gulyavarsánd). This results in a total of 29 measurable Bronze Age horse teeth and mandibles to compare. Unfortunately, none of my samples had intact nuchal crests or incisive bones to measure for Type 4 or 5 wear.

Six teeth in my sample (45.45 %) exhibited wear that meet the diagnostic criteria established by Anthony and Brown (2011) and Bendrey (2007a), (1) with beval measurements > 3 mm and (4) with EDH > 5 mm (Figures 7.11 and 7.12). What I found most striking about these teeth are the variations in wear. The known bits are those discussed in Chapter 6, which also exhibit a wide range of variation. The cheekpieces were of antler and the mouthpieces were organic materials. My impression when examining teeth with Type 1 and Type 2 wear on the LP2s is that the organic mouthpieces wore the teeth in a wide variety of ways. Type 3 wear of the mandibles was light (2 scoring a 1). Scoring by all methods captured the variation of wear I observed. Some teeth had one type of wear and not the other, and some had both. Microscopic findings were inconclusive, as to be expected with organic bits. Only hard bits leave wear.

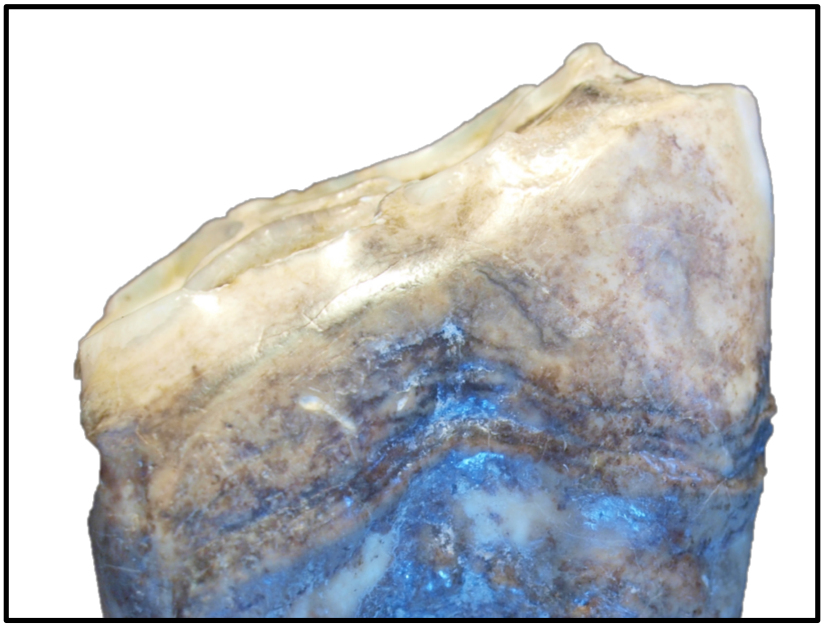

Figure 7.11. Example of a Bevel on a LP2 from MBA Százhalombatta-Földvár.

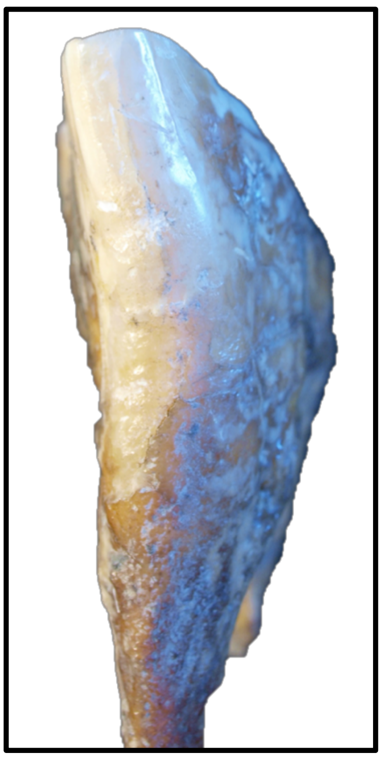

Figure 7.12. Example of Anterior Enamel Exposure on a LP2 from MBA Százhalombatta-Földvár.

Diedrich (2017:23–24; Figures 11c, 12A, 12B) documents unusual concave wear to the anterior edge of the LP2s on historic mining horses. He attributes this to wear from bits. I observed similar concave wear that I interpret as wear from the consistent pressure of a bit from one specimen each from Százhalombatta-Földvár and Kiryalók Útja 293 (Figure 7.8). The specimen pictured did not have a bevel, but did demonstrate substantial anterior enamel exposure. While limited in sample size, these additional observations support the varied nature of horse bit wear. Different horses with different bits and different riders exhibit divergent bit wear signatures.

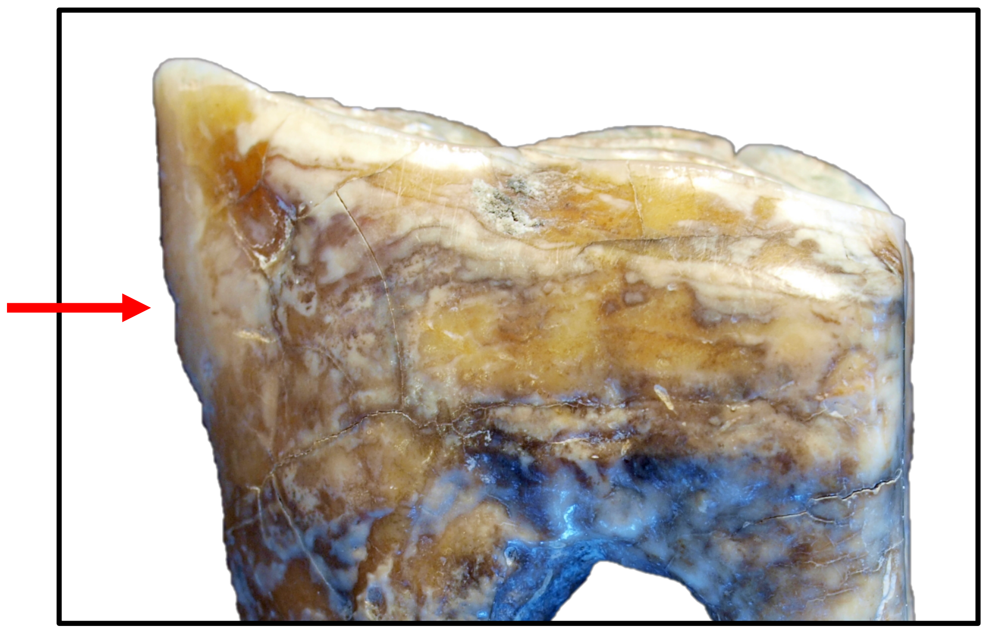

Figure 7.13. Concave Indention on a LP2 from MBA Százhalombatta-Földvár.

The degree of wear is consistent with horses that were lightly to moderately used. A method for distinguishing riding versus draught has not yet been developed on the basis of bit wear. However, Anthony et al. (2006:146–147) report a significantly higher degree of wear on several horses' LP2s that were recovered in chariot burials on the steppes, bevels of 6.0, 5.0, and 4.0

respectively. My suspicion is that draught or chariot use will consistently leave a higher measureable degree of wear to the LP2s and diastema due to the increased pressure on the teeth, mandibles, and skull, and the use of a check-rein, which can force the bit onto the teeth with greater frequency. Moreover, the position of the wear may be more oriented at the gum line. Bendrey (2007a) recorded the opposite effect, with ridden horses having a higher degree of changes. However, the horses were modern and the bits were metal. I would expect the different uses to be differentially recorded on the teeth of prehistoric horses with organic mouthpiece bits. This is an area to test in the future.

Post-Cranial Skeletal Pathologies in Horses

Conformation, environment, nutrition, age, growth, weight, and husbandry practices all may initiate and affect so-called naturally occurring changes in the skeleton of the horse. Direct trauma, infection, overuse, work on concussive or uneven surfaces, or repetitive use can all cause various injuries to the muscles, ligaments, tendon, and bone. Bone remodeling may subsequently occur as an adaptive response to direct injury or mechanical loading and then leave archaeologically visible ostoepathologic evidence of the type of trauma the horse incurred. Traumatic, infectious, and age related osseous changes on extinct wild equids and osteoarthritis in feral horses have been documented (Cantley et al. 1999; Rooney 1997). Riding or draught can induce and further exacerbate strain on particular parts of the body, when the body cannot tolerate the overstress of such work, and leave potentially diagnostic osseous markers of such activities (Bartosiewicz and Gál 2013; Onar et al. 2012; Telldahl 2012).

In modern horses, anatomical location of orthopedic disease has been correlated with the type and intensity of the sport in which the horse is used (Ruas de Sousa et al. 2017; Murray et al.

2006). The spinal column, hip, shoulder, and limb bones have been identified as areas where diagnostic work-related pathologies in horses may be found in archaeological populations (Baker and Brothwell 1980; Bendrey 2007a; Levine et al. 2000; 2005).

> For example, it appears that shoulder and hip injuries are particularly characteristic of traction. On the other hand, injuries to the caudal thoracic and lumbar vertebrae seem to be primarily associated with riding. Lower limb bone injuries probably have more complicated explanations. Relatively high rates of such pathologies seem to be found in both riding and heavy traction animals, particularly those which have been worked on roads rather than open ground (Levine et al. 2000:125).

For this research, I examined generally what osteopathologies of the horse are visible in their skeletal remains from Hungarian Bronze Age and highlight which of the osteopathologies may be indicative of how horses of the were used. The etiology of osseous pathologies is always multifactorial, but drawing on modern veterinary research and archaeological studies, I parse out what may be evident as use-related wear on horse bones, particularly in an effort to identify if horses were ridden, driven, or both.

Description of Osteopathologies of Horse Bones

Conditions of bone are *periostitis, osteitis, osteomylitis, physitis, fractures, degenerative joint disease (DJD also known as osteoarthritis), ankylosis, osteochrondrosis, subchondral bone cysts, and septic arthritis* (Butler et al. 2017). The visible manifestations of these conditions on bone as the bone responds to stress can be ossifications in the form of *exostoses, osteophytes,* and *enthesophytes. Exotosis* is the formation of new bone on the surface of the bone. Intra-articular exotoses, those in the joint surface, and peri-articular exotoses, those around the joint articulation, are *osteophytes.* Extra-articular bone growths that forms at tendon or ligament attachments are *entheosophytes.* In DJD, features evident on bones may include: *lipping,* the osteophytic

development of a sharp ridge and / or spicule formation on the joint surface (which may result in *anykylosis* or the fusion of the joint); *porosity* or pitting on the surface of the bone; and *eburnation*, or bone-on-bone polish with a typical ivory color which may include grooves on the articular surface.

Periostitis is inflammation of the periosteum (the thin, tough membrane that covers bone) from direct trauma or lifting of the periosteum at tendon and ligament attachment points away from underlying bone. Common sites of periostitis in the horse are the small metacarpal and metatarsal bones (so-called *splints*) and the large metacarpal and metatarsal bones (MCIII or MTIII, colloquially called cannon bones). *Splints* are *desmoiditis ossificans ligamentum interosseum* or ossification of the interosseous ligaments of the metacarpals or metatarsals. *Periostitis secondary to muscle or ligament strain* occurs at tendon or ligament attachments where new bone production is stimulated resulting in enthesophytes. Common locations for periostitis secondary to muscle or ligament strain are the metapodia and phalanges.

Osteitis is inflammation of bone. The most common conditions of osteitis in the horse pedal osteitis and sesamoiditis. *Pedal osteitis* is inflammation of the distal (third) phalanx (also called the pedal bone or coffin bone) that results in demineralization of the bone. Sesamoiditis is a term loosely applied to several conditions involving the sesamoid bones. Changes associated with the sesamoid bones include new bone growths on the sesamoid bones (the result of tearing of attachments of the suspensory ligament) and areas of mineralization within the sesamoidean ligaments.

Osteomylitis is infection of bone and in horses occurs following a deep wound. *Physitis* is abnormal bone activity in the growth plate (physis), usually the lower growth plate of the radius.

The condition may be related to *osteochondrosis,* a problem common to modern horses resulting from breeding large, fast growing individuals and is as yet unknown prehistorically (Becker 2007). Osteochondrosis (OCD) is a developmental abnormality of cartilage and bone which occurs in young, rapidly growing individuals, identified in most joints, the stifle and hock joints are most commonly affected in the hind leg and the shoulder joint in the front leg, generally evident within the first two years of life. In OCD during bone growth the cartilage is converted to bone. *Subchondral bone cysts*, holes in the bone close to the articular surface, have not been reported archaeologically, and may be related to modern breeding and selection practices as well.

Fractures may be complete or partial, simple (with two distinct pieces) or comminuted (with multiple pieces). Spiral fractures, common in long bones, are typically from twisting forces while compression fractures occur from loading forces, generally known in the vertebrae. Depressed fractures stem from direct blows occur frequently in crania. "Chip" or osteochondral fractures are quite common in race and performance horses, as they are associated with trauma from joint overextension in fast exercise (Brokken et al. 2016; Declercq et al. 2009; 2011). The most common sites of fractures in horses are of the *cannon bone* (third metacarpal or MCIII), the *pastern bone* (first or proximal phalanx), the sesamoids, and the bones of the knee (Baxter 2011).

Secondary (Degenerative) Joint Disease (Osteoarthritis or DJD) begins with the degradation of articular cartilage, which may occur secondarily to soft-tissue injuries that cause inflammation of the soft-tissue structures of the joint (*synovitis* and *capsulitis*) (Riggs 2006; Ruas de Sousa et al. 2017). At later stages of the disease, osseous changes occur as the cartilage continues to breakdown. DJD may be traumatic in origin, such as incited by a severe sprain, or stem from conformational abnormalities, age related changes, or work. Horses of all ages can

develop DJD and all the above factors may be a part of the pathogenesis of this disease. The lower-limb joints – the knee, hock, fetlock, pastern and coffin joints – are more commonly affected than the upper-limb joints. *Bone spavin* (hock or tarsal joint), *ringbone* (of the fetlock at the metacarpophalangeal joint or the pastern at the proximal interphalangeal joint), and *sidebone* (coffin or distal interphalangeal joint) are common examples (Adams and Baxter 2011; Baxter 2011; Dyson and Murray 2007; Lindner 2006; McIlwraith et al. 2012; Santischi 2008). The spine is also regularly affected (Haussler et al. 1999). *Septic arthritis* is an infection in the joint, most commonly from a perforating injury of the joint, and may result in a number of osteomylitic bony changes.

Rates and Locations of Osteopathologies in Modern and Archaeological Populations

Surveys in modern horses of the rates of lameness can give a reasonable expectation of what to anticipate in archaeological populations. In a survey in the US, rates of lameness range from 3.4% to 5.4% (United States Department of Agriculture 2000:1). Estimates of DJD in horses from this survey that exhibited lameness may be up to 60% (McIlwraith et al. 2012:297). UK rates of lameness affect 23% of the equine population, with 16.8% originating in the limb and 5.1% in the spine (Slater 2017:4). Injury incidence in a population of polo ponies was identified at 10.6%, with tendon injuries 4.3%, wounds 2.5%, and splints 12.5% (Inness and Morgan 2014). In horses competing in lower level eventing, rates of injury were 28.1%, where soft-tissue injuries were most common followed by joint and foot/hoof pathologies (Caston and Burzette 2018).

The epidemiology of osteopathologies in modern horses are best known from racing Thoroughbreds, as these are large populations of working horses who receive regular veterinary

care and extensive study due to their economic impact. Racing Thoroughbreds also have a higher incidence of injury than the general population of horses, but are also trained to saddle as early as a year old and are raced at two years of age. Hard and fast work at this young age likely increases the rate of injury. “Musculoskeletal (MS) injuries are the most common health problem in Thoroughbred racehorses and represent a major cost to the Thoroughbred industry. Studies of horses in training have reported that the incidence risk of MS injuries ranged from 36% in a 2-year-study to over 50% [in shorter term studies]” (Cogger et al. 2008:473). *Bucked shins* (*periostitis of the dorsal cannon bones*, also called *dorsal metacarpal disease*) and fetlock problems were the most common MSI affecting 42% and 25% of horses, respectively (Bailey et al. 1999:487). MSI are the main cause of euthanasia in racehorses (Jeffcott et al. 1982).

Fractures are the most common catastrophic injuries (Johnson et al. 1994; Parkin et al. 2004); in particular, lateral condylar (spiral) fractures of the metapodia cause the most fatalities (Parkin et al. 2004; Tranquille et al. 2012). Fractures are also common in the general horse population, and accounted for 13.8% of the cases admitted in a recent survey (Gadallah et al. 2014). Chip fractures are a common performance horse problem, but do not always cause fatal injury, rather a loss of or decrease in performance (Nunamaker et al. 1990; Riggs 2006). Pathologies of the spine, specifically *impingement and overridings of the dorsal spinous processes* (Kissing Spines Syndrome) are also incredibly common as they affected up to 97% of a sample of Thoroughbreds in training, and may be related to the very early training to saddle of Thoroughbred racehorses and their more prominent withers (Haussler et al. 1999).

Several surveys of archaeological horses document the past rates of osteopathologies, which may or may not have been associated with lameness at the horse’s time of death. Daugnora

and Thomas (2005) found the teeth, vertebrae, and lower limb bones of fore and hind to be the most common areas of osseous pathology on early Medieval horses from Middle Lithuania. Thirty-five (12.5%) of the 280 horse skeletons had some form of pathology, the most common were splints (43%, 13 on metacarpals, 5 on metatarsals) and bone spavin (deformation of the hock or tarsus, 37%). In an earlier survey of the medieval Lithuanian riding horses, these authors found consistent post-cranial skeletal weaknesses in the metarcarpals, the hock, and the lumbar vertebrae. "The fact that the majority of the recorded pathologies could be categorized as arthopathic might be viewed as evidence to suggest that the horses from Middle Lithuania were used for riding or traction" (Daugnora and Thomas 2005:72).

Onar et al. (2012:140) evaluated 20 Byzantine horses skeletons (1618 NISP). In this sample, 16.3% exhibit pathologies, with 61.8% of the pathologies recorded post-cranially and 38.1% cranially, including teeth. Marković et al. (2015) documented osteopathologies of Roman cattle and horses from the hippodrome, emperor's palace and residences in the city of Sirmium and Vranj in Pannonia (Serbia). Horses were used extensively in sport at the hippodrome, but they found less extensive pathologic changes in horses when compared to cattle, but the percentage of pathologies was higher in horses at both locales (Sirmium 0.67% in cattle, 2.2% in horse; Vranj 1.1% cattle to 11% horse). In these horses, the hock (tibio-tarsal joint) showed signs of osteoarthritis (grooving, eburnation, and exotoses); a tibia had examples of ossification of the medial maleolus, scaley bone deposits, osteophytes, sclerosis, and decreased density; while the most frequently documented changes were splints of the metacarpals, where exotoses were also noted proximally and distally. Second in frequency were entheoseophytes of the proximal and

middle phalanx. No infectious or metabolic diseases or fractures were recorded, in contrast to cattle.

As in modern horses, DJD is a common paleopathology of horses, typically understood as a result of the work-related skeletal stress (Baker and Brothwell 1980; Stevanović et al. 2015):

> the most prevalent degenerative joint diseases that can be found in archaeozoological material are bone spavin and ring bone in horses and cattle. The etiology of the bone spavin and ringbone is similar to osteoarthrosis [DJD] generally. Rather, there is almost no paleopathological survey in which these joint abnormalities are not described. What is interesting is the fact that bone spavin and ring bone even today have a high clinical importance in veterinary orthopedy of sport horses (Stevanović et al. 2015:8).

Dzierzęcka et al. (2008:693) report fracture as the most commonly recorded pathology of Iron Age and Middle Age horses from Poland. Also found were exotosis, periostitis, oseomyletis, DJD (arthopathia deformans), ankylosis (arthopathia anklopoetica). The Iron Age La Tène horses (400 BC to 1st C AD) had a high prevalence of bone spavin of the hock, ringbone of the pastern and coffin joints, and ankylosis of the coffin joint. Limb bones were identified as the location of the most frequent osseous pathologies in both Iron Age (700 BC to 1200 AD) and Middle Age (5th to 13th century AD) equine populations.

Infectious and disease related osteopathologies are important for understanding horse husbandry in a larger context, for example the treatment and management of such cases in prehistory. These are mostly documented as single cases, rather than in surveys of archaeological horses. Bendrey et al. (2011:114) discovered a case of Iron Age *poll evil* from and Early Scythian horse skull from Tuva Central Asia. Poll evil can result in a “highly irregular, hypertrophic projection at the external occipital protuberance” from inflammation and necrosis following a bacterial injection of the supra-atlantal bursae. Bendrey et al. (2008) and Bendrey (2008a) found two Iron Age horse skeletons from Britain with possible bacterial osteomylitits. In the Viables

Farm skeleton, the atlas, two thoracic vertebrae, the sacrum, four rib fragments, and the right os coxae showed such pathological changes while in the Downlands skeleton eight vertebrae and ribs were the sites of the disease. Severe osteomylitic exotoses were also found on a hindlimb of a Roman horse from western Slovakia that stemmed from “the septic inflammation process as a consequence of the complicated wound of the tarsal region or the tarsal joint perforating trauma” (Janeczek et al. 2010:331). In the 5th century BC Macedonia, Greece, long-term management was evident in aftercare of a horse with a compound fracture of the third metacarpal with osteomylitis (Antikas 2008).

However, the primary focus of this research is to document diagnostic work related pathologies in order to understand exactly how horses were exploited in the Hungarian Bronze Age. As outlined above by Levine et al. (2005), in surveys of archaeological populations as well as in modern horses, the most common areas of injury that manifest in osseous changes of the post-cranial skeleton are the lower legs (especially in the forelimbs) and spine, while less common in the pelvis and shoulder. Rates of osteopathologies for populations of archaeological horses vary from 1.1 to 16.3%. This fits relatively closely to modern incidence of lameness in the horse, which ranges from 3.4 to 28.1%, and is less than racing Thoroughbreds recording a higher incidence up to 36% or even over 50%. If the frequency of osteopathologies in archaeological populations of horses reaches over the 20% range, this would suggest a very high intensity of use.

The incidence of osseous pathologies related to the lameness rates in the modern population data are unknown, but is in all likelihood less than the reported frequency of lameness. However, DJD is figured to play a significant role and would be manifested in osteopathologies. Splints of the metapodia (predominately the forelimbs), bone spavin in the hock, entheseophytes of the

proximal phalanx, and DJD of the spine are the most common findings in the archaeological samples. Similarly, in modern populations, the forelimb and spine are the most common areas of injury for both general riding horses and racing Thoroughbreds.

The Spine

The spine may exhibit the best diagnostic indicators of riding or chariotry in archaeological horses. Common osteopathologies of the spine and pelvis incurred in modern riding horses are: *impingement and overridings of the dorsal spinous processes (Kissing Spines Syndrome* or KSS*); osteoarthritis [DJD];* and *fractures* (Baxter 2011). Back pain in modern horses is exceedingly common (Clayton 2012; Clayton and Hobbs 2017; de Graaf et al. 2015; Haussler et al. 1999; Zimmerman et al. 2012). The weight of the rider or a pack applies significant forces to the horse's back (Fruehwirth et al. 2004; Winkelmayr et al. 2006). "It causes extension of the thoracolumbar spine (hollowing of the horse's back) both when the horse is standing and during locomotion" (Clayton and Hobbs 2017:126). The weight a horse carries along with the tack used, frequency and quality of work, and skill of the rider all play a roll in the etiology of spinal dysfunction (Geser-von Peinen et al. 2010). Thoracolumbar osseous pathologies often develop (Alves et al. 2007; Girodroux et al. 2009; Meehan et al. 2009; Zimmerman et al. 2011; 2012).

de Cocq and van Weeren (2004) tested the effect of human weight on horses and saddle fit causing the onset of KSS. Weight induces a significant overall extension of the back, which may contribute to both soft tissue injuries and the impingement and overridings of the dorsal spinous processes. The frequency of occurrence of abnormal spinous processes in the thracolumbar spine of riding horses without clinical signs of back problems reached 79%, and included structural

changes along the borders of the spinous processes and decreased width of interspinous spaces occurring randomly from T10 to L2 (Erichsen et al. 2004). Thus, KSS is a frequent pathology of ridden horses.

Stress fractures of the caudal thoracic and lumbrosacral regions of the spine are also frequent skeletal maladies of Thoroughbred racehorses. Haussler and Stover (1998) report 61% in a sample of horses that died at racetracks over a year period in California had evidence of stress fractures in the caudal thoracic and lumbrosacral regions of the spine. Additionally, vertebral lamina stress fractures occurred in 50% of the sample and were associated with the severity of kissing spines syndrome and severity of articular process degenerative changes.

In archaeological populations, Bartosiewicz and Bartosiewicz (2002:819) suggest that, "Vertebral fusions in middle aged or old riding and draught horses is usually attributed to repetitive strain injury (RSI) and old age". Levine et al. (2005) find Early Iron Age Scythian riding horses from Siberia exhibit abnormalities of the caudal thoracic vertebrae (T11-T19), which distinguish them from both the free ranging Exmoor ponies of England and Chinese chariot horses. Similar to the studies of modern horses, they document the following pathologies: (1) deposition of spondylotic spurs of new bone on the ventral and lateral surfaces of the vertebral bodies adjacent to the intervertebral space; (2) overriding or impinging dorsal spinous processes; (3) fissures through the epiphyses; and (4) periarticular osteophytes on and above adjacent articular processes between vertebrae.

Neither the Exmoor ponies, even those of advanced age, or medieval horses exhibit these abnormalities of the caudal thoracic vertebrae. Levine et al. (2000; 2005) importantly suggest that riding is the main cause of abnormalities of the caudal thoracic vertebrae and that it is the type of

saddle used, pad in the Early Iron Age horses and frame in the medieval horses, which affects the incidence of vertebral pathologies. In modern studies, bareback riding actually exerts more force and pressure and causes more stress to the horse's spine than riding with a saddle (Clayton et al. 2012; Peham et al. 2010). Riding with a pad saddle, where the rider is in as near as close contact to the horse's back as bareback, clearly had similar consequences to the equine spine. Bertašius and Daugnora (2001) evaluated skeletons from medieval Lithuanian riding horses burials (8th to 11th century), horses excavated in assorted Norwegian archaeological sites and cemeteries (Oseberg graves 9th to 12th century, Gokstadskippet, Norway), and modern Fjordhorses and Dølehorses (from 1920 to 1953, Norway). He found a similar pattern of damage to the lumbar spine in the medieval riding horses from his Lithuanian sample as Levine et al. (2005). Equine confirmation, different human directed selection pressures, and saddle type probably all play a role in the differences observed in these samples. Bronze Age horses were most likely ridden bareback or with a pad saddle, so the presence of osteopathologies of the thoracolumbar spine are likely to be indicative of riding.

Two basic forms of vertebral fusions that are not always clearly distinguishable archaeologically are *spondylosis ankylopoetica*, which is fusion of the synovial joints by osteophytes, and *sponylosis chronica deformans*, fusion of vertebral bodies by osteophytes on the ventral side (Morgan 1967). Bartosiewicz and Bartosiewicz (2002) documented a case of 'bamboo spine' (*spondylosis anklyopoetica*) in an Avar period horse from Hungary, likely an inherited, rather than riding-related condition. They statistically differentiate this horse's condition from the more caudal thoracic and lumbar oriented vertebral fusions of *sponylosis chronica deformans* reported by Wells (1964) in 83 protohistoric horses. Daugnora and Thomas (2005), Janeczek et al.

(2014), and Marković et al. (2015) find similar *sponylosis chronica deformans* in archaeological cases as induced by riding. Plukowski et al. (2009) found vertebral comparable fusion in two horse spines, one with a horizontal fissure in a thoracic vertebra, to be a probable result of riding.

Schrader et al. (2018) document degeneration of the first thoracic vertebrae and ribs with bilateral osteoarthritis of the elbow (antebrachiohumeral or cubital) joint in an Egyptian chariot horse from Thombos. They relate the axial changes to the use of the horse to pull a chariot as the chariot saddle harness “sits directly at the base of the neck an imparts particular stress to this part of the skeleton” (Schrader et al. 2018:391). They also report another case of an 18th Dynasty chariot horse is mentioned with similar pathologies. These changes to the first thoracic vertebrae and ribs and the elbow joint might well represent a good expression of chariot-induced pathologies as they are quite unlike those documented for riding horses above.

Shoulder and Hip

In equine draught, shoulder (scapula/humerus) and hip (coxofemoral joint) damage is suggested to characteristic of traction-induced pathologies, because of the pressure of the harness across the shoulder, the additional weight of the vehicle and load on the hindlimbs, and additional force required by the hindlimbs to propel the vehicle (Levine et al. 2000; 2005). Unfortunately, modern populations of harness horses are not that useful to compare to prehistoric populations. Racing in harness is performed at an exaggerated trot or pace (an extra gait) and the cart (sulky) and its driver are extremely lightweight. The injuries to racing Standardbreds (the breed that races in harness) are generally like racing Thoroughbreds but less extensive (Bertuglia et al. 2014). Modern draught work using horses in the United States is generally performed by heavy (or

draught/draft) horses that are quite unlike prehistoric horses, or by former racing Standardbreds driven by the Amish on pavement. The best possible comparisons would be from historically known populations of light harness horses, but this research is non-existent as of yet. Even more frustratingly, there are no surveys and exceedingly few reports of the osteopathologies of known chariot horses, so documentation of particular osteopathologies of the shoulder and hip in chariot horses are almost unknown. The above recently reported examples of bilateral elbow arthritis in Egyptian chariot horses are tantalizing, and may represent another possible location of draught related pathologies in prehistoric horses (Schrader et al. 2018).

Draught related osteopathologies are better studied in cattle. Shoulder and hip pathologies related to draught in cattle, include exotoses in the scapula and eburnation in the acetabula of the pelvis and caput femoris (Baker and Brothwell 1980; Bartosiewicz 2008; Bartosiewicz et al. 1997; De Cupere et al. 2000; De Cupere and Waelkens 2002; Groot 2005; Telldahl 2005; 2012). Bartosiewicz et al. (1997) usefully compared archaeologically known bony pathologies with those in modern Romanian cattle. Draught cattle have high rates of eburnation to the acetabula (Groot 2005). Bendrey (2007d:99) analyzed and Iron Age horse from Danebury castle and found slight changes to the acetabula, not comparable in impact to those observed on draught cattle. This may be more consistent with the age related changes documented in this individual.

Legs

Common osteopathologies incurred in the legs of modern horses include: *DJD of the metacarpophalangeal / metatarsophalangeal joint,* the *proximal* and *distal interphalangeal joints* (including *ringbone* and *sidebone*)*,* and hock (*chronica defomans tarsi* or *bone spavin*, including

ankylosis of the hock); *pedal osteitis; navicular; periostisis; sesamoiditis; bucked shins (acute periostitis on the dorsal surface of the third metacarpal bone); splints;* and *fractures* (Baxter 2011). The horse's forelegs take about 75% of the body weight, so the forelimbs receive the most osteological changes of all joints in the appendicular skeleton, especially under repetitive hard work. Of the forelimb joints, "The fetlock joint has the largest number of traumatic and degenerative lesions of all joints of the appendicular skeleton" (Brommer et al. 2003:697). Fractures and DJD are the most common conditions.

Kane et al. (2003a; 2003b) evaluated the fetlocks, carpi, tarsi, stifles, and fore feet of 1162 Thoroughbreds at the time of the yearling sale and again at ages 2 and 3. In the yearling exam, they found some irregularities in proximal sesamoid bones to be very common (over 80%) in the population. Other osteopathologies present were fractures of the first phalanxes, bone chips present in the distal third metacarpus and the distal third metatarsus (the fore and hind cannon bones as they articulate with the pasterns), bone chips of the proximal phalanx, fracture of the ridge of the distal tibia, and osteochrondritis. After they began training and racing, chronic inflammation of the fetlock joint and the manifestation of DJD was present and continued its progression in many of the horses previously found to have radiographic irregularities (Kane et al. 2003b). In Warmbloods, chip fractures of the metacarpo-/metatarsophalangeal joints were detected in around 20% of two separate large populations (Declercq et al. 2009; Hilla and Distl 2013). In 461 Thoroughbred racehorses, 88% of dorsoproximal P1 chip fractures occurred in the forelimbs (Colón et al. 2000). "Many bone injuries are a consequence of repeated high loading during fast work resulting in chronic damage accumulation and material fatigue of bone. The highest joint

loads occur in the fetlock, which is also the most common site of subchondral bone injury in racehorses" (Martig et al. 2014:408).

The most regular osteopathology of hindlimbs in modern horses is bone spavin of the hock. Bone spavin is DJD of the hock with excessive exostosis or bone destruction of the joints often followed by ankylosis. Lameness can be severe in the acute stages and nearly completely resolved after the joints fuse. In modern elite competition horses, especially *dressage* horses and *show jumpers,* who exhibit an increased engagement of the hindquarters at high competition levels, changes to the distal tarsal joints of the hock, centrodistal (CD) and tarsometatarsal (TDT) joints, were related to the specific movements required by these horses in competition and the repetitive nature of training (Dyson 2002; Tranquille et al. 2012) Hock dysfunction was specifically linked to increase the prevalence of DJD of the hock. "Ridden exercise may increase the risk of osteochondral lesions at distal tarsal sites predisposed to osteoarthritis relative to the risk with nonridden exercise" (Tranquille et al. 2011:33).

Bone spavin is also unusually common in Icelandic horses aged 6-12 years, but may be more related to the conformation of this specific population (Bjornsdottir et al. 2004). Bjornsdottir et al. (2003) found that bone spavin was the most common reason for culling riding horses, but that they were utilized as such before the disease rendered them unserviceably sound. As bone spavin is common to other breeds and particular sporting disciplines, it could be a useful tool for archaeologists in tracking the development of breeds or in differentiating use in the presence of additional pathologies. Icelandic horses are "gaited", meaning they have additional gaits in comparison to the walk-trot-canter/gallop of non-gaited horses called the tölt and skeið/flugskeið, which could also be related to the incidence of this pathology. Their introduction to Iceland as a

small number of animals in the Viking Age, and efforts to continue their restricted bloodlines, point to a strong hereditary factor to the development of bone spavin in this population as well. In all cases of bone spavin, it appears that human intervention has led to these osteological changes in one way or another through selective and restrictive breeding practices and various training regimes.

Archaeological examples of osteological pathologies of the legs are common as discussed above. Bartosiewicz and Gal (2013) described the distal appendicular skeleton as the core area of bone tissue pathologies in ancient working animals and have been observed in equine skeletal remains from various periods. In draught cattle, osseous pathologies of the legs include lipping and exotosis of the proximal joint surfaces of the metapodia and planagies, asymmetry of the distal metapodials, palmar and distal depressions of the metapodia, and grooving of the articular surfaces of the metapodia and phalanges (Baker and Brothwell 1980; Bartosiewicz 2008; Bartosiewicz, Van Neer, and Lentacker 1997; De Cupere et al. 2000; De Cupere and Waelkens 2002; Groot 2005; Telldahl 2005; 2012). Bone spavin in the hock is reported as a routine find in chariot horses (Antikas 2011:6), but there does not appear to be published supporting literature for these finds. In Medieveal and Post-Medieval Leicestershire, UK, a high incidence of bone spavin was discovered on a number of horses, which was suggested to be related to draught related use (Baxter 1996). The hock is a key joint for propelling the body, especially as the weight of the load increases or the horse is asked to carry more weight on its hindlimbs. Bone spavin of the hock may well be more common in draught horses, as well as ridden horses who are asked to carry a lot of weight on the hindlimb. The hock may be an additional area of pathology related to driving, like the shoulder and hip, when these pathologies are found together.

Bendrey (2007b:99–100) examined splints of the metapodia, one of the most commonly documented osteopathologies of archaeological horses. While zoo-kept unworked Prezewalski's horses were identified with splints in this study, and thus thought to be largely age related, this periostitis resulting in ossification of interosseous ligaments of the small or accessory metacarpals (MCI & MCII) and metatarsals (MTI & MTII) to the third metacarpals and metatarsals is also thought to stem from conformation and work, as Bendrey notes. As to be expected in the multifactorial etiology of the osseous pathologies of the lower limbs, splints are a pathology that can be so-called naturally occurring, and in the Pzrewalski's Horses may be a consequence of zoo husbandry on hard surfaces and restricted breeding resulting in poor conformation. Splints may be equally related to work-related stress especially when seen in conjunction with additional other pathologies. In the population of medieval horse skeletons from Lithuania and in the Roman horses, splints were the most common pathology recorded, more frequently found on metacarpals than metatarsals because of the increased weight distribution on the horse's forelimbs, especially when ridden (Daugnora and Thomas 2005; Marković et al. 2015). Marković et al. (2015:624) find "There are many possible causes of these pathological changes, like trauma and/or labour on hard surfaces, as well as conformational faults contributing to the process…Dystrophic calcifications are in the majority cases the result of reduced tissue vitality, local tissue degeneration or inflammatory processes, occurring due to stress and aging".

In the metacarpophalangeal (fetlock) joints of wild horses in New Zealand, Cantley et al. (1999) found bony lesions on the proximodorsal aspect of the first phalanx (P1/pastern bone) that increased in severity with the horse's age. "We have identified an age related osteoarthritic process naturally present in horses; and postulate that the stresses of racing and training may accelerate

this ageing process" (Cantley et al. 1999:73). Rooney (1997:44) found viritually no evidence for arthrosis (DJD) in extinct equids and concluded "arthrosis is in large part a function of human use of horses". While he did document nonarticular periostoses of phalanges in areas of ligamentous insertion, only two were found in the species most similar to domesticated horses while more were found in the three-toed Parahippus, a species not comparable. Exotoses of the proximal phalanx have been reported as naturally occurring and not of any particular consequence to archaeological materials (Bendrey 2007:100, Figure 3). However, this pathology, like many in horses is dependent on conformation, may be naturally occurring, and can be significantly exacerbated by human mediated activity, clearly suggested by the DJD observed in the fetlock joints of modern Thoroughbreds after they began training and racing. The horse's workload combined with age related changes, like those observed in the wild New Zealand population, increases the spread of DJD in the fetlock. This can indicate to archaeologists that horses with these lesions had an increased intensity of use, especially if they occur in younger individuals (unlike in Bendrey's Iron Age case).

In an Avar period horse, "Pathological changes in form of exostoses, sequential to the ossification of collateral ligaments insertion points were revealed on the proximal phalanges (the long pastern bone) both in the thoracic and in the pelvic limb. The chronic ossifying periostitis was also confirmed by radiology" (Marković et al. 2014:622). Following Thompson (2007) Marković et al. (2014:624) suggest that, "chronic ossifying periostitis can develop as a result of organism reaction due to some traumas, so it is local and non-infectious in character". Horses from the Medieval Russian site of Gnezdovo also have evidence of this pathology of the proximal phalanx. Kirillova and Spasskaya (2015:98) suggest that intensive use under saddle caused or

exacerbated this ossification and horses developed “well-developed tubercles for attachment of ligaments on the lateral surface of phalanges 1, which result from increased locomotor load”.

Nonarticular periostoses of phalanges in areas of ligamentous insertion is often called ringbone, which actually can be articular (indicating DJD) or non-articular as in the case of chronic ossifying periostitis of the proximal phalanges. Ringbone is the laymen’s term often used to describe any exotoses on the phalanges, while sometimes it is used to refer to joints only (Dyson 2002), so there is some confusion in the terminology. When the location is in the proximal phalanges at the insertion of the collateral ligaments, it is high, non-articular ringbone (Schramme and Labens 2012). Low ringbone may also occur at the coffin joint, the articulation between the second and distal phalanges. This condition is caused from chronic microtrauma to ligamentous and tendinous attachments and is worse with poor conformation (Baxter 2011). It generally causes severe lameness in the acute stages that often resolves with ossification, has a high probability of re-injury, and is thought to be a consequence of high-speed exercise with sudden turns and stops (polo, cow work) or overwork on hard or uneven ground (Sherlock and Mair 2006; Wollenman et al. 2003).

Articular ringbone (DJD) may result in arthodesis (ankylosis) of the joint, and a great degree of pain relief for the animal, whereby some utility of the horse can be salvaged either in lower level work or as a breeding animal. While these changes can occur in modern and extinct wild (or feral) equids, they should be documented and discussed in archaeological materials because in modern horses, work is thought to play a strong role in the etiology of this condition. In archaeological cases, exotoses can be seen on the eminence for the attachment of distal oblique

sesamoidean ligament, the axial and abaxial palmar/plantar ligaments and lateral collateral ligaments of the pastern, or the proximal digital annular ligament.

The hooves are one of the most frequent sites for lameness in the modern horse (Adams and Baxter 2011; Baxter 2011; Dyson and Murray 2011). In terms of bony pathologies that are visible archaeologically, sidebones, the ossification of the collateral cartilages of the distal phalanx, occurs most often in the lateral cartilage. In modern horses, sidebones are more often a consequence of a large horse with small feet, or an animal carrying a heavy load, and are less associated with lameness and pain. In an Avar horse, Marcović et al. (2015:624) document sidebone on all of the distal phalanges, without clear causative factors:

> The theories concerning the etiology of *ossificatio cartilaginis ungulae* (sidebone) include hereditary predispositions, trauma or concussion of the hooves, bad shoeing and hoof imbalance. Asymmetric calcifications observed also show that the strain and stress predisposed along the stronger ossification side of the distal phalanges was increased during the life of the horse. Since Avar horses were not shoed [shod] we can exclude bad shoeing as an etiological factor impacting the development of the distal phalanx cartilage ossification in this horse. However, horses with ossified hoof cartilage do not always show signs of lameness and that was possible in our ancient animal.

Summary of the Osteopathologies of Horses

In sum, the most common osteopathologies of both modern and archaeological horses occur on the legs and spine and less commonly in the pelvis and shoulder. The spine offers the best promise for discerning riding versus chariotry in the locations and extent of pathologies. Riding appears to affect the caudal thoracolumbar spine while chariotry likely affects the cranial thoracic spine and ribs. The pelvis and shoulder should hold evidence for draught induced pathologies in horses, but the archaeological evidence is limited and the modern studies not comparable. The legs have the most common expressions of bony lesions observable in modern

and archaeological populations. However, their etiology is more multifactorial than the spine and cannot simply be linked to a specific use without additional data. In all cases, inherited conformation and disposition, husbandry practices, and environment may predispose horses to the development of osteopathologies as much as the type and frequency of use the horse receives. Documenting all osseous changes in a sample population is key in the context of additional archaeological and zooarchaeolgical evidence.

Methods for Identifying Post-Cranial Osteopathologies in Horses

There is not an overall established zooarchaeological methodology for recording post-cranial osteopathologies in horses. For this study, I evaluated the horse bones from seven sites of the Hungarian Bronze Age: Százhalombatta-Földvár, Királyok-Útja 293, Gáborján-Csapszékpart, Bakonseg-Kádárdomb, Berettyóújfalu-Szihalóm, Dunakeszi-Székesdűlő and MOBP06-Pécel02. I first recorded a simple absence or presence of any pathology on every bone in the sample by site and by period. I pool this to create the rates of pathologies documented for Bronze Age horses in Hungary, which I further delinate by the location and type of pathology. I adapted paleopathological recording systems developed for cattle (Bartosiewicz et al. 1997; De Cupere et al. 2000) and recorded for pathologies of the equine spine (Bartosiewicz and Bartosiewicz 2002; Levine et al. 2005) and the metapodia (Bendrey 2007).

The methods of Bartosiewicz et al. (1997) record the presence and extent of osteoarthritis. I altered this to simple severity of pathology recorded from Stage 1 to Stage 4. For each individual bone a score of *stage 1* represents minor changes, *stage 2* indicates moderate changes, in *stage 3* there are well-defined changes, and *stage 4* represents extreme changes for the majority of lesions.

Following de Cupre et al. (2000:258), after Baker and Brothwell (1980:115), DJD can then be diagnosed for an articular surface where there are three of the following changes: eburnation, gooving, lipping, and osteophyetes. Rates of DJD in my sample populations are given from these critera.

Bartosiewicz and Bartosiewicz (2002:208) created the standard for recording pathologies of the spine in horses after the five morphological stages of vertebral fusion in dogs. A score of (1) represents normal; a (2) has osteophytes that do not project beyond the end of the vertebrae; a score of (3) the osteophytes project beyond the end of the vertebrae; in a (4) osteophytes project beyond the end of the adjacent vertebrae; and in a score of (5) osteophytes between adjacent vertebrae fuse so that the joint becomes rigid. With a score of (5) representing ankylosis, an additional five diagnostic expressions of the fusion are scored, each from 1-4, including ossified ligaments on the spinous and transverse processes; fusion of small articulations; syndesmophyte formation between the vertebral bodies; complete fusion between the lateral and ventral edges of vertebral bodies; and finally bamboo spine, with the visible ossification of the long ventral ligament in a glazelike spondylotic crust. In addition, the presence or absence of the conditions noted by Levine et al. (2005:98) will be noted. These are the (1) deposition of spondylotic spurs of new bone on the ventral and lateral surfaces of the vertebral bodies adjacent to the intervertebral space; (2) overriding or impinging dorsal spinous processes (KSS); (3) horizontal fissures through the epiphyses; and (4) periarticular osteophytes on and above adjacent articular processes between vertebrae.

Bendrey (in addition to his bit wear and cranial scoring systems) developed a standardized scoring for splints (2007b:208–210). The severity of expression of ligament ossification for the

interosseous border between metapodials ranges in five stages (0, 1a, 1b, 1c, and 2) from (0) with no ossification to (2) metapodials attached and new bone deposition clearly bridges the interosseous border.

Analysis of Post-Cranial Horse Bones of the Hungarian Bronze Age

The total overall rate of post-cranial (PC) osteopathologies in horses from all the sites in my sample of the Hungarian Bronze is 4.92%. This fits within the rates of injury in modern horses and the rates of osteopathologies in archaeological populations. Including the bit-wear and cranial pathologies (BW-C), the rate is 5.81%. PC osteopathology rates from Roman horses range from 2.2% to 11% (Marković et al. 2015); to 10.07% PC and 16.3% BW-C/PC in 4th century Byzantine horses (Onar et al. 2012); and BW-C/PC rates at 12.5% in medieval horses (Daugnora and Thomas 2005). In these later periods, horses were documented to be intensively used for riding and/or traction. Interestingly, the osteopathological rates from the Hungarian Bronze Age are higher (nearly double) than those recorded in horses found at the Hippodrome in Smirmia (Marković et al. 2015). In modern populations in the US, the 3.4-5.4% rates of injury are closest to the osteopathological rates of the Hungarian Bronze Age. Modern horses in the US are largely used for light to moderate pleasure riding at a non-competitive level (United States Department of Agriculture 2000). Modern horses that are more intensively used in competition range from 10.6% in a population of polo ponies (Inness and Morgan 2014) to over 30% and even upwards of 50% in racing Thoroughbreds.

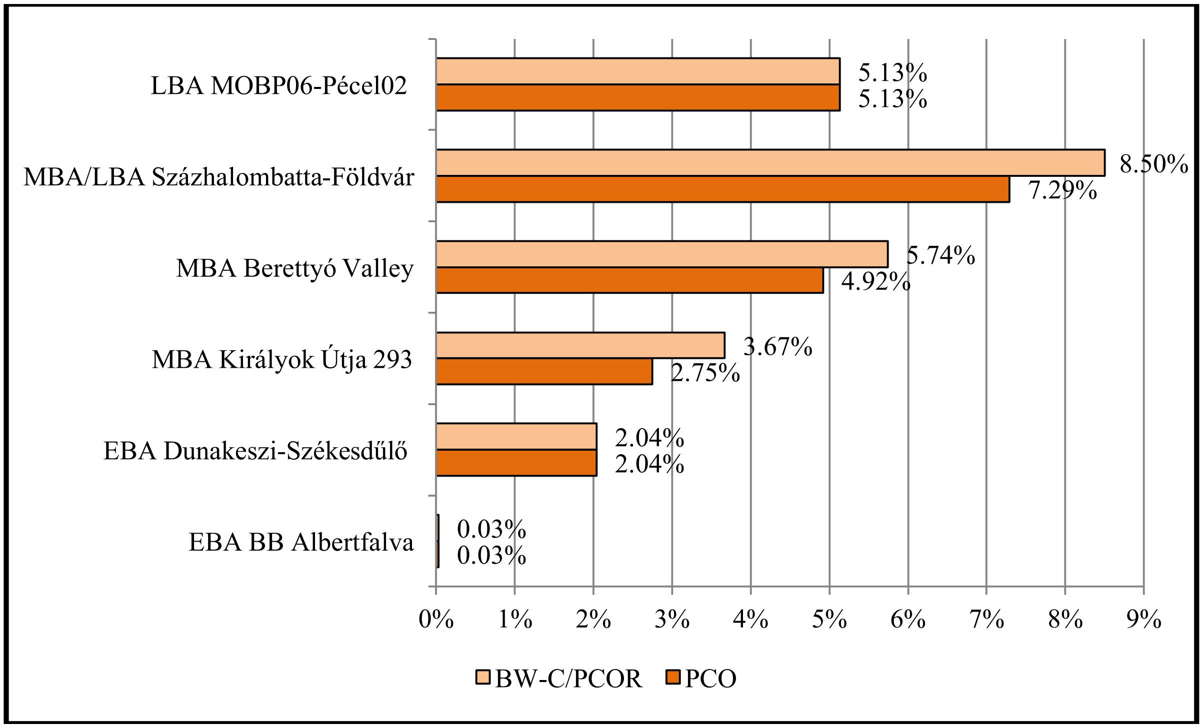

Figure 7.14. Percentage of Osseous Pathologies of the Total Horse Bone Assemblages from Bronze Age Hungarian Sites.

Percentages of osteopathologies are 7.29% PC and 8.50% C/PC from MBA/LBA Százhalombatta-Földvár and 2.75% PC and 3.67% C/PC from MBA Királyok Útja 293. The percentages are higher from two Berettyó Valley sites, but the samples I examined are smaller N<50, as are the samples from EBA Dunakeszi-Székesdűlő and from LBA MOBP06-Pécel02 so the osteopathology rates must be understood with this in mind (Figure 7.14). MBA Gáborján-Csapszékpart has a 14.29% PC osteopathology rate, but the sample is only 21 NISP. MBA Bakonseg-Kádárdomb is 3.90%, and the NISP is 77. Summed, the MBA Berettyó Valley rates are more consistent with the larger samples with 4.92% PC, 5.74% C/PC (Gáborján-Csapszékpart having 1 tooth with evidence of bit-wear). No osseous pathologies were found in the Berettyóújfalu-Szilhálom sample. EBA Dunakeszi-Székesdűlő had a 2.04% total osteopathology

rate (NISP 49 in the sample I evaluated with no bit-wear present) and LBA MOBP06-Pécel02 had a 5.13% total oseopathology rate (NISP 39 with no bit-wear present).

Comparatively through time, the very large sample from EBA BB Albertfalva (NISP 3304) only had one bone with evidence of pathology, so the rate was 0.03% (Lyublyanovics 2016:204). As the EBA Hungarian sites show 0.03% to 2.04% and the MBA sites range from 3.67 (KU) to 8.50% (SZHB) overall, the incidence of osteopathologies in horses increases from the EBA to the MBA. Comparatively by site, the horses from Vatya Százhalombatta-Földvár have obvious higher rates of pathology than those from Vatya Királyok Útja 293. Not surprisingly, the average age of the horses from Százhalombatta-Földvár is 11.2 in the MBA to 12 in the LBA, while at Királyok Útja 293, the average age is 5.42 years. This probably points to the effect of age-related osteopathological changes in addition to probable use-related changes.

Consistent with the locations of osseous pathologies in archaeological and modern populations, the most frequent site of osteopathology was on the lower forelimbs (N=27, 84.38%), especially the proximal (N=7) and second phalanx (N=7). Other areas of osseous changes include the metapodia, hock, radius and tibia. Unfortunately, the lack of axial skeletons recovered from Bronze Age Hungarian sites (Chapter 6) limits my ability to analyze these particular areas for evidence of riding induced osseous pathologies. There were only three vertebral fragments present from all of the samples I examined (all from Százhalombatta-Földvár), none of which were complete enough to evaluate.

Enthesopathies from *chronic ossifiying periostitis secondary to ligament strain* were the most common finding (50.00%). These occurred at the insertions of the oblique sesamoidean ligaments (N=5) and abaxial palmar (N=2) ligaments of the proximal phalanx, the collateral

ligaments of the DIP joint of the middle phalanx (N=7), and the extensor tendon attachment of the distal radius (N=2). The next most common osseous pathologies were bone spavin (*chronica deformans tarsi*: 21.88%), splints (*desmoiditis ossificans ligamentum interosseum*: 6.25%), and ossification of the lateral cartilage of the distal phalanx (*ossificatio cartilaginis ungulae*: 6.25%). The severity of the lesions was mostly light (81.82%) to moderate (3.03%), with the fused distal tarsal joints of the hock, a chip fracture of the dorsal proximal phalanx, and a probable subchondral bone cyst demonstrating more severe pathology (15.15%). No bones exhibit the most extreme extent of the pathologies for draught cattle (stage 4) recorded by Bartosiewicz et al. (1997). Both cases of splints are relatively mild, a 1b on the Bendrey (2007b) scale. The rate of DJD is 31.25%.

There is a rather high rate of enthesopathies from chronic ossifying periositis secondary to ligament strain in these Bronze Age samples. Something is clearly afoot with these results. Close to a third (28.95%) of the phalanx at Százhalombatta-Földvár have enthesopathies. A multifactorial etiology related to use, conformation, and age-related changes or even trauma is probable. Also of likely importance is the relationship between the 4 inch (10.16 cm) increase in wither's height, the increase in slenderness of the distal limbs, and the high incidence of these pathologies of the proximal and middle phalanges. Increase in height and selection for type may have resulted in a long, sloping pastern (incorporating the metacarpo/metatarsophalangeal joint, the proximal phalanx, the sesamoids, the proximal interphalangeal joint, the middle phalanx, the distal interphalangeal joint, and distal phalanx, the navicular bone, and all the related tendons and ligaments). Presence of a long, sloping pastern is related to an increase in joint instability and injury (Adams and Baxter 2011; Baxter 2011; Butler et al. 2000; Dyson 2002; Lindner 2006). A long, sloping pastern also increases rider comfort. Selection for a larger, more comfortable riding

horse may be related to the high prevalence of entheseopathies of ligamentous insertions in the proximal and middle phalanx and the ossification of the lateral cartilages in the distal phalanx. Use as riding horses potentially exacerbated the conformational predisposition for these changes.

The rate of DJD, bone spavin of the hock, and splints of the metacarpals and metatarsals also speak to use-related uses in these populations. While documented in feral and zoo populations, these conditions are common to athletic competition and racehorses, and exacerbated by more intensive and fast use on hard ground. They also generally cause a noticeable lameness, which generally resolves after ankylosis occurs. That the horses were not culled when the lameness was obvious is reason to suspect their equestrian use was more important than their carcass use, which the mortality profiles in Chapter 5 and the body part representation in Chapter 6 both suggest.

Two finds were surprising: a healed chip fracture of the dorsoproximal phalanx (Figures 7.15 and 7.16) and the probable osteochondral bone cyst on the sagittal ridge of the distal metacarpal (Figure 7.17). Both of these finds were from Királyok Útja 293. This chip fracture is very common in racehorses and is probably related to the suggested increased laxity in the ligaments of the pastern as this malady often occurs with overextension of this joint. This would have resulted in obvious lameness.

> ‘Chip’ fractures of the dorsoproximal aspect of P1 typically involve the medial aspect of the joint and occur in horses that exercise at speed. These fractures are normally traumatic in origin and result from hyperextension of the fetlock joint. Acute lameness and increased effusion in the fetlock joint along with sensitivity to firm flexion of the fetlock are clinical signs that a fracture may be present and radiographic examination indicated (Brokken et al. 2016:361).

This incomplete and non-displaced fracture healed completely. DJD occurred in this joint as a result of the fracture, as evidenced by periarticular osteophytes, eburnation, lipping of the articular surface, and the presence of grooves. This specimen also was found in situ with its middle and

distal phalanx above the corner of building "B". This perhaps could be an intentional head and hoof deposit of an important horse that was nursed through an acute injury in order to continue its use.

Figure 7.15. Healed Chip / Osteochondral Fracture of the Left Hind Dorsoproximal Phalanx.

Figure 7.16. Chip fracture of the Dorsoproximal Phalanx and its Related Middle and Distal Phalanx. Found Together in the Corner of Building B from Királyok Útja 293.

A probable subchondral cystic lesion was found on the sagittal ridge of a distal metacarpal (Figure 7.17). The pathogenesis of these lesions is not well understood, but may be related to trauma of the articular surface or result from the developmental disorder of osteochondrosis (Boswell 2016). Horses of all ages may have these lesions, but they are more common in younger horses, and the population at Királyok Útja 293 was younger than contemporaneous MBA population. This specimen is from an adult animal, over the age of 1.5 years as the metacarpus fuses at 18 months (Evans et al. 1994). Lameness associated with subchondral systic lesions is

usually evident and may be quite severe. Given its location on the sagittal ridge of the distal metacarpal, which bears a significant amount of the body weight of horses, lameness was most likely very severe. This horse would have had great difficulty bearing weight on this limb.

Figure 7.17. Subchondral Cystic Lesion on the Sagittal Ridge of a Distal Metacarpal from Királyok Útja 293.

Summary of the Bit-Wear/Cranial and Post-Cranial Osteopathologies of the Horses of the Hungarian Bronze Age

All of the post-cranial osseous paleopathologies represent the earliest findings of such in the archeological literature, and that alone makes them important. As yet, none of the sites associated with early domestication have published summaries of post-cranial paleopathologies, and only bit-wear has been documented from the Copper Age sites of Botai. Rooney (1997) connects arthodesis (OA/DJD) to domesticated horses, and unsurprisingly, 31.25% of the horse

bones with pathology in this study showed evidence of some DJD. Use, selection, increased age at death are all consequences of domestication and these horses of the Hungarian Bronze Age demonstrate these effects. Three main factors probably all affect the expression of osteopathologies of the horses of the Hungarian Bronze Age: 1) conformation, 2) age, and 3) work.

The increase in the variation and size of the phalanges (Chapter 5) may have direct consequences for the prevalence of osseous pathologies on this particular element. Increased length of the proximal and middle phalanges may be related to human selection for larger horses and/or horses that are more comfortable to ride. Longer, sloping pasterns improve rider comfort as this conformational feature increases shock absorption. Long, sloping pasterns also have a higher incidence of DJD, ligament and tendon injury that may result in ossification related to periostitis, and chip fracture. All three of these problems were present in the MBA populations.

Age-related changes were likely involved in the rates of DJD in the population from Százhalombatta-Földvár, as the horses reached a relatively old age in this popultion, 11-12.5 years at death. Workload probably exacerbated age related DJD or induced it via trauma at a younger age, as is commonly found in modern aged equines (Riggs 2006). The severity of pathology ranges from light to moderate and this probably indicates frequent, but not excessive, use of horses. This speaks more likely to daily herding of other livestock than intensive use in warfare or repeated fast long distance travel, though these practices are certainly possible given the osteopathological evidence. The fact that horses were not culled after repetitive soft tissue injuries resulting in osseous pathologies, or in once case a chip-fracture, and that these horses survived the probable acute phase of lameness that would accompany these injuries, is most likely indicative of their high equestrian value and the lesser value of their carcass products. This is supported by the

mortality profiles (Chapter 5) and the body part representation (Chapter 6). These horses were apparently used and cared for rather carefully and not culled once they exhibited lameness. The lower rate of osteopathologies is in contrast to the heavy exploitation and maltreatment horses often received in later periods of time (cf. medieval/post-medieval cases).

The radical increase in osseous pathologies from the EBA BB site of Albertfalva to the MBA sites in the same region likely speaks to increased exploitation of horses for ridden work. The bit-wear evident on some of the horses from the Hungarian Bronze Age is in line with both the bit finds (Chapter 6) and the probable use as mounts. While none of the paleopathologies recorded here are definitive evidence of riding, they are more consistent with the pathologies of known ridden horses in archaeological and modern populations. None of the post-cranial pathologies speak directly to draught use. Without the presence of vertebrae to analyze, confirming riding based on the osteopathologies of the Bronze Age horses of Hungary is not yet possible. Human osteopathologies of habitual riding offer the best possible way to address this issue.

CHAPTER 8

Becoming Equestrian:
Human Skeletal Pathologies from Bronze Age Hungary

Human skeletal remains are the last line of evidence used here to evaluate human-horse relationships and their potential impact on the development of centralized polities, political economies, and social stratification of the Hungarian Bronze Age. If horses were the mounts of a new class of elite warriors, in this case elite males as postulated by Earle and Kristiansen (2010), the bones of the people who rode should show osteopathologies indicative of this activity. Examining human remains for osteological markers of riding can determine if people were riding, and who was riding. There should be evidence of the emergent centralized and stratified social organization of society by class and gender from the human skeletal remains if horses were important these developments. However, I document demonstrably through bioarchaeological analysis, that people were riding horses, riding was widespread, and that it was not restricted by class or sex as early as the beginning of the MBA. Riding was likely common millinnea earlier but I did not evaluate EBA or Copper Age samples for this study.

As shown in the previous chapter, general points of human contact on horses occur in their mouth and head, from the bridle and bit, their spines, from the weight of the rider, and their axial skeleton and legs from repetitive movements of riding and driving. In humans that ride, the pelvis, spine, and legs take the brunt of impact, with thorax and arms secondary (Lagarde et al. 2005; Pugh and Bolin 2004). For drivers, the reverse is true where the head, hands, and feet typically show the greatest effect of physical trauma for equestrian pursuits. A diagram of the human skeleton is provided in Figure 8.1 for reference. Training, riding and working around horses may be physically taxing and repetitive labor but it also can be dangerous. Horses can be unpredictable,

especially to the uninitiated; they are very quick in their actions when frightened, and exceptionally strong. They are prey animals and respond as such; they fight (kick/rear/buck) or flee (run) when scared. Trauma physicians Exadaktylos et al. (2002:573) sum up this sentiment.

> The possible lethal power of a horse—which is capable of delivering a kick with a force of up to one ton—was described by the ancient Arabs with the proverb "The grave yawns for the horseman". Horseback riding accidents and injuries caused by horses carry a high risk of severe trauma. In addition, a horse's kick can transfer a force of more than 10 000 Newtons to the body, causing fractures of the skull or other bones as well as devastating damage to the intestines.

Skeletal pathologies may be witness to the repetitive or traumatic damage acquired by equestrians through frequent contact with horses. In this chapter, I examine the clinical literature on injuries to horse riders and rider biomechanics in order pinpoint areas of the skeleton that likely record the stress and trauma of habitual riding. Then I identify the potential archaeologically identifiable skeletal pathologies of riders in order to conduct a bioarchaeological analysis of a sample of skeletons from the MBA and LBA Hungary, compared to earlier and later periods in Hungary for control. My sample is examined in context of other contemporaneous osteological analyses for evidence of violence and warfare, and for the timing of the appearance of osseous markers on the skeleton related to habitual riding.

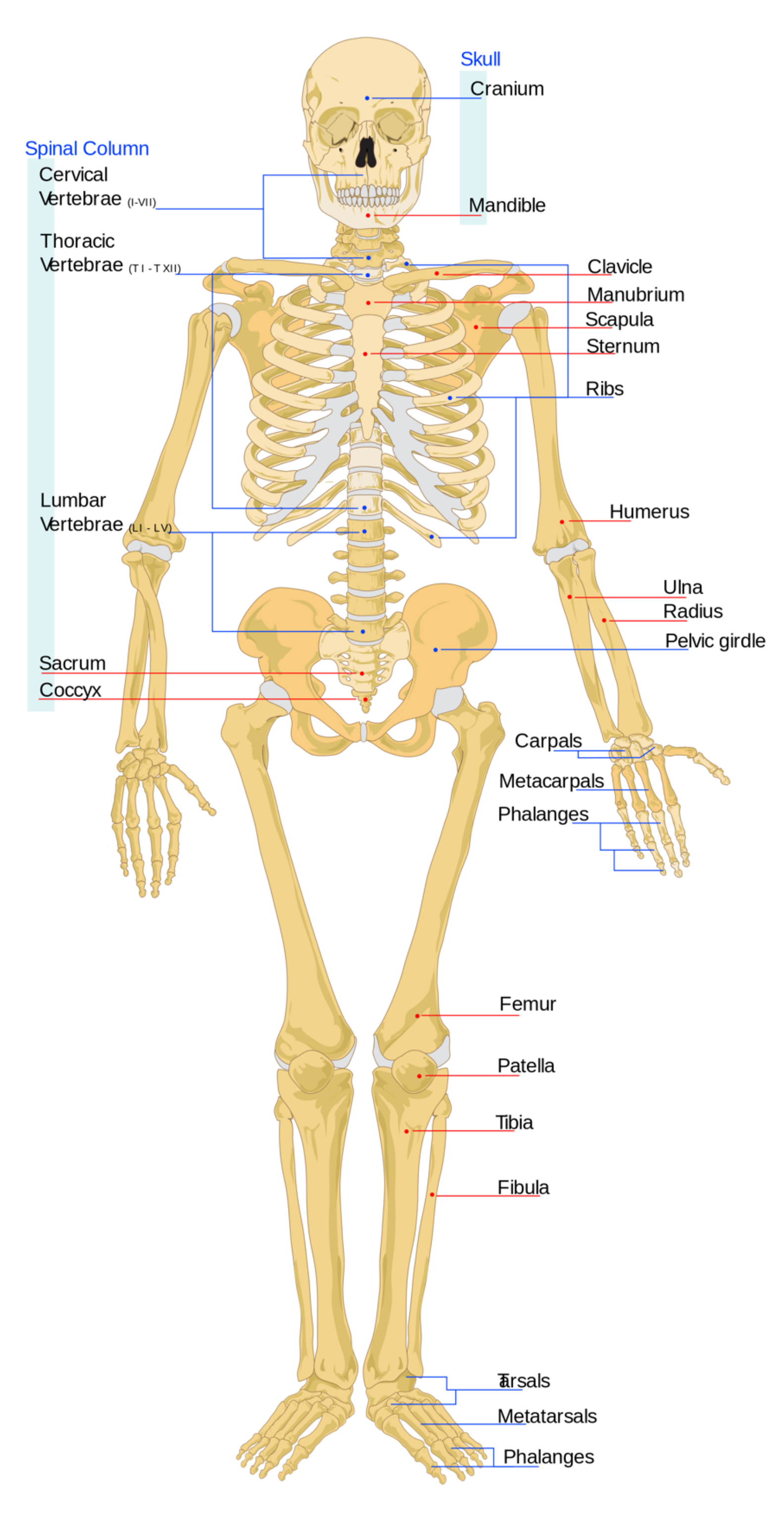

Figure 8.1. Diagram of a Human Skeleton (Wikimedia Commons contributors 2018).

Modern Equestrian Injuries

Riding has the highest mortality rate of all sports and a higher rate of severe injury (Clarke et al. 2008; Young et al. 2015). Reported rates of injury range significantly from 1 for every 350 to 1000 hours spent riding (Carmichael et al. 2014; Silver 2002); 18.7 injuries per 100,000 rides (Hobbs et al. 1994); 1 accident for every 158,607 hours of United States Pony Club activities (Griffen et al. 2002); to 7.8 injuries per 1000 game-hours for polo players (Costa-Paz et al. 1999). Musculoskeletal or orthopedic injuries are the most common injury to modern equestrians, reported as between 60-70% (Clarke et al. 2008; Holland et al. 2001; Loder 2008). The injury pattern to the body shows the extremities receive the majority of injury, followed by the head, spine, thorax, face, pelvis, and abdomen (Hasler et al. 2011; Young et al. 2015). The most common mechanism of injury is fall from a horse, followed by crush injuries, kicks, kicks, bites and trampling (Clarke et al. 2008; Young et al. 2015). The manual labor of horse husbandry also contributes significantly to injury (Hausberger et al. 2008; Löfqvist et al. 2009; Löfqvist and Pinzke 2011; Parkin et al. 2018; Pilato et al. 2017; Swanberg et al. 2013).

Most studies show that upper extremities have the highest rate of injury (Young et al. 2015:2), but a recent study of intercollegiate equestrians that accounts for repetitive strain injury (RSI) found over 60% of all injuries reported were to the lower extremities (Pilato et al. 2017:7). The vast majority of injury rates and anatomical patterning comes from Emergency Room collected data, so there is an over privileging of traumatic injury, such as fracture. RSI and overuse injuries are less well reported. In fact, bone fracture is the most common horse related injury that causes emergency room visits in the US and abroad (Exadaktylos et al. 2002; Chitnavis et al. 1996; Moss et al. 2002; Thomas et al. 2006; Ueeck et al. 2004; Young et al. 2015). The frequency and

locations of fractures are as follows, in decreasing order of frequency: upper trunk (ribs, clavicle, upper spine), lower arm, wrist, shoulder, lower spine, finger, ankle, lower leg, upper arm, elbow, face, foot, hand, toe, head, upper leg, knee, neck, pelvis, and mouth.

Studies of professional horseracing jockeys and other professional horsemen and horsewomen have pinpointed injuries common to habitual equestrians (Press et al. 1993; Simonetti et al. 1996; Tsirikos et al. 2001; Waller et al. 2000). In a three-year study of 2700 licensed jockeys from 1993 to 1996 recorded a total of 6545 injuries occurred during official races and roughly 1 and 5 of those injuries was to the jockey's head or neck (Waller et al. 2000). Frequent injury sites also included the legs, foot/ankle, back, arm/hand, and shoulder. The injuries mainly occurred in rider falls. A survey of 706 profession jockeys yielded similar results (Press et al. 1993). Jockeys in this sample incurred 1700 injuries throughout their lifetimes. Stemming from falls, fractures accounted for 64% of the total injuries and 65% of the fractures were of the leg, shoulder, and arm.

The long-term effects of riding on the spine have been studied in jockeys and Olympic level horse professionals (Tsirikos et al. 2001; Simonetti et al. 1996). These equestrians ride multiple horses nearly every day of the year. In the jockey study, 32 jockeys were observed and radiographed for 13 years and the results were compared with age-matched, normal population control groups. Tsirikos et al. (2001:561) state,

> The incidence of degenerative changes of the spine was higher in the jockeys compared with the control groups and was more prominent in the older age group for both the lumbar and cervical spine. These findings suggest that equestrian sports, particularly professional horse riding, apart from the increased risk of direct spinal injury caused by a fall from the horse, can lead to progressive spine degeneration as a result of repetitive trauma and increased physical stress on the spine.

Simonetti et al. (1996:542) describe the specific changes to the lumbrosacral spines of professional horse people in their study. The MRI (magnetic resonance imaging) results of equestrians were

compared to an age-matched control group: With the equestrians, four areas of higher pathology in the lumbrosacral spine were identified: “1) changes in normal bending and angles of the lumbar spine; 2) injuries and changes in lumbar disks; 3) changes in spinal ligaments; 4) vertebral body injuries”.

Overuse injuries beyond the spine are less well studied and reported, as they are usually less traumatic in origin (Pugh and Bolin 2004). The low back, pelvis, legs, and upper body are the most common areas of RSI of horse riders. “The highest forces during riding are absorbed through the rider’s ischial tuberosities, pelvis, sacrum, and lumbar spine” (Pugh and Bolin 2004:300). The rates of osteoarthritis (OA) and injury to the spine, as indicated above, highlight the changes that occur within it related to riding and horse husbandry. Riders absorb significant forces with their lumbar spines in extension, which can result in spondylolysis and spondylolisthesis. Riders also exhibit hypermobility and rotation in the pelvis.

The pelvis, sacrum, and lumbar spine are key points to examine for potential Markers of Stress (MOS) or Musculoskeletal Stress Markers (MSM) to the human skeleton related to riding, now termed Entheseal Changes (EC) after Jurmain et al. (2012). As with overuse injuries in horses, insertion points (entheses) for the muscles, tendons, ligaments may ossify and be observable in archaeologically recovered human remains. The muscles that stabilize and assist with balance and directional control in the rider are centered on the pelvis, spine, and legs, as discussed below, as are their entheses (Table 8.1). Additionaly, “Because the shoulders and upper back are the endpoint of contact with the horse’s mouth, these structures are susceptible to pain from overuse…The muscles involved in scapulothoracic stabilization include all segments of the trapezius, the rhomboids, and serratus muscles” (Jurmain et al. 2012:299).

In sum, the injury and overuse rates among equestrians are quite high. Musculoskeltal injuries are exceedingly common to equestrians, with fractures to the upper extremities being the most common, followed by head and spine injuries. High fracture rates in an archaeological population may indicate a life in the saddle as may head or spine injuries. Overuse to the spine, pelvis, and lower limbs are also common because of the unique strains riding puts on the body. This overuse may be discernable archaeologically by the appearance of osteoarthritis (OA/DJD), and entheseal changes (EC) to the human skeleton in the bones of these regions.

Rider Biomechanics

Riding is a very complex anatomical process that is even challenging to quantify today (Clayton and Hobbs 2017; Lagarde et al. 2005). It puts a person in a position that is almost unlike any other activity and thus places unique, and potentially diagnostic, stresses on the body. "The horse and the rider share tactile information through points of contact at the saddle, rein, stirrups, and between the legs of the rider and the trunk of the horse. At those particular points, information pick-up is a function of the relative motions of the horse and rider" (Legarde et al. 2005:421). The rider sits on the horse in an artificial *genu varum* (or bow-legged) position (Figures 8.2 and 8.3). The width of the horse's barrel (thorax) affects the width between the rider's legs and activity of the body. The pelvis and thighs provide the center of contact. The pelvis mediates and transmits forces directly between horse and rider (Engell et al. 2016). The pelvis is usually rotated posteriorly and the trunk anteriorly, even if traditional *equitation* (the art and practice of riding or the rider's position) practices suggest other positions. The legs are somewhat flexed forward at the hip and bent at the knee, but also regularly extended from the hip through the barrel of the horse (without

stirrups). The lumbar spine is usually in extension, but lordosis is flattened when the rider tucks the pelvis anteriorally to drive the horse through weight via the ischial tuberosities. The coxo-femoral joint is open, but the pelvis also variously externally and internally rotates when the thighs are activated.

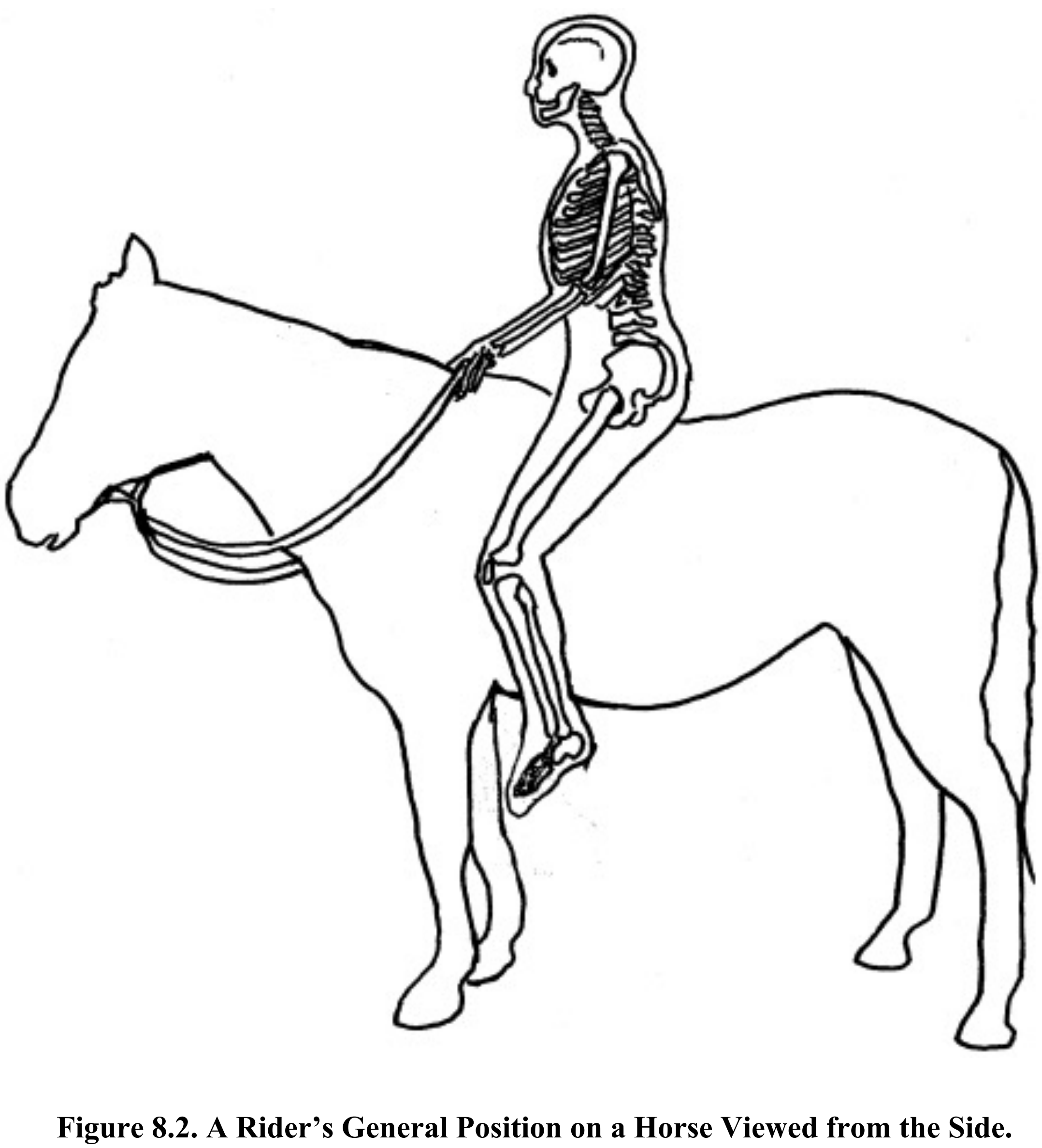

Figure 8.2. A Rider's General Position on a Horse Viewed from the Side.

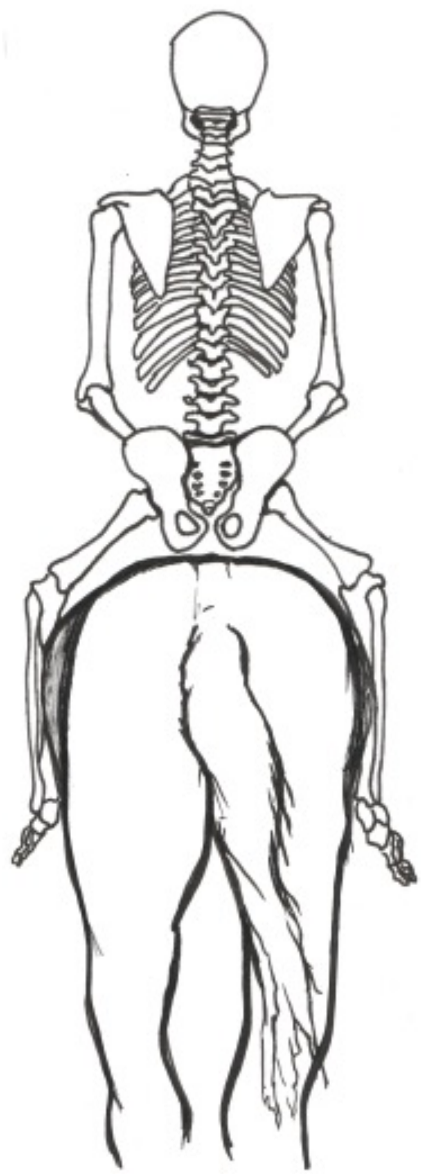

Figure 8.3. A Rider's General Position on a Horse Viewed from the Rear.

The thighs adduct and abduct to maintain position, contact, and balance on the back and barrel of the horse. They activate together or singularly to provide cues with knees, calves, and heels. The horse is trained to move away from the pressure of a single calf or heel, or forward with

both. The legs rotate medially and laterally at the pelvis to provide stability and further direction. The rider's core muscles do a great deal of work to stabilize the pelvis and rider position. The upper body should be relaxed, but the arms, scapula, and thoracic spine work together to provide direction via the reins (either held in both or one hand), to turn, stop, or increase the speed of the horse in concert with the legs and weight aids.

Obviously bareback, or even with a simple pad saddle, the contact between the horse's and rider's bodies is closer and different than with stirrups, and the introduction of the frame saddle and stirrup do cause changes in rider position and additional RSI and observable osseous pathology, especially at the knee (Baillif-Ducros et al. 2014; Baillif-Ducros and Mcglynn 2013). However, the general position and motion of the rider's body is maintained bareback and with a saddle, but the leg is extended longer down the barrel of the horse. Without stirrups, the foot is relaxed, extended, and plantar flexed. With stirrups, the foot is dorsiflexed, and this causes additional strain on the femoral-patellar joint.

A posterior tilt of the pelvis and an anterior tilt of the trunk have been repeatedly shown to be the most common characteristic of rider biomechanics (Alexander et al. 2015; Clayton and Hobbs 2017; Eckardt and Witte 2016; 2017; Engell et al. 2016; Hobbs et al. 2014; Terada et al. 2004).

> In this matter, the pelvis is considered as the "center of movement" that determines the coordination between upper body and legs. Particularly the movement of the pelvis is said to play the key role in controlling a horse as it connects the rider's body with the horse physically. Moreover, relevant muscles for horse riding (abdominal, back, hip, and thigh muscles) run from upper body and thighs to the pelvis (Münz et al. 2013:950).
>
> The rider's pelvis is particularly important since it has direct contact with the saddle so pelvic motion is crucial to a rider's success. During riding the pelvis primarily rotates (pitches) in the sagittal plane around a transverse axis. The direction of pelvic pitch is determined according to whether the upper part of the pelvis rotates posteriorly (positive

> pitch) or anteriorly (negative pitch) relative to the lower part. Pelvic roll occurs around the anteroposterioraxis and is observed from in front or behind…Pelvic yaw occurs around the vertical axis. Yaw rotation to the left occurs when the left side of the pelvis twists posteriorly (positive yaw) (Clayton and Hobbs 2017:126).

The pelvis, femurs, and spine are the center of activities of the rider's body. They coordinate the activity of riding and are highlighted as the anatomical structures that endure its repetitive physicality. These anatomical areas are then the most probable locations to provide diagnostic osseous pathologies indicative of habitual riding.

Archaeological Research of Rider's Syndrome

A suite of osteopathologies called the "Cavalier's Syndrome", "Rider's Syndrome", or "Knight's Syndrome" has been described in the archaeological literature for some time (Angel 1982; Baillif-Ducros 2011; 2013; Baillif-Ducros et al. 2011; 2014; Baillif-Ducros and Mcglynn 2013; Baillif-Ducros and Yvinec 2015; Blondiaux 1994; Buzhilova 2010; Larentis 2017; Miller 1992; Miller and Reinhard 1991; Molleson and Blondiaux 1994; Pálfi 1992; 1997; Pálfi and Dutour 1996; Reinhard et al. 1994). This osteologically evident suite of pathologies mirrors those areas of the human body that sustain RSI and from the unique musculoskeletal activities involved in riding and demonstrated by modern riders. Trauma endured by archaeological individuals is similar to the injury body patterning of modern equestrians. Baillif-Ducros et al. (2011) have usefully reviewed and identified the locations of EC and DJD particular to riders reported in the literature (Tables 8.1 and 8.2). As highlighted above by rider biomechanics, they are centered on the pelvis, femur, and spine. The patella and calcaneus also are of importance after stirrups are introduced.

Area of Insertion	Muscle	Action
Ischial tuberosity	*Biceps Femoris*	Flexes at knee Extends thigh at hip joint
	Semitendinous	Flexes and slightly medially roates leg at knee joint after flexion Extends thigh at hip joint
	Semimebranous	Flexes and slightly medially rotates leg at knee joint after flexion Extends thigh at hip joint
	Adductor magnus	Adducts thigh at hip joint Assists in lateral rotation and extension
Linea aspera	*Vasus lateralis*	Extends leg at knee
	Adductor magnus	Adducts thigh at hip joint Assists in lateral rotation and extension
	Adductor longus	Assists thigh at hip joint Assists in lateral rotation
	Adductor brevis	Adducts thigh at hip joint Assists in lateral rotation
Lateral and medial supracondylar tubers	*Gastrocnemius*	Plantar flexes foot Flexes foot at knne
Lesser trochanter	*Psoas major*	Flexes thigh at hip Flexes vertebral column
	Illiacus	Flexes thigh at hip
Orbital line of the femur	*Pectineus*	Flexes and adducts thigh at hip joint Medially rotates thigh
Posterior superior iliac spine	*Gluteus maximus*	Extends and laterally rotates hip joint Extends trunk
Gluteal tuberosity	*Adductor magnus*	Adducts thigh at hip joint Assists in lateral rotation and extension
	Gluteus maximus	Extends and laterally rotates hip joint Extends trunk
External iliac fossa	*Gluteus medius*	Abducts femur at hip joint Rotates thigh medially
	Gluteus minimus	Abducts femur at hip joint Rotates thigh medially
Greater trochanter	*Gluteus medius*	Abducts femur at hip joint Rotates thigh medially
	Gluteus minimus	Abducts femur at hip joint Rotates thigh medially
Tubers of the adductor	*Adductor magnus*	Adducts thigh at hip joint Assists in lateral rotation and extension
Patella	*Quadriceps femoris*	Laterally rotates thigh at hip joint
	Rectus femoris	Extends leg at knee joint Flexes thigh at hip joint
	Vastus lateralis	Extends leg at knee joint
	Vastus medialis	Extends leg at knee joint
Trochanteric fossa	*Obturator externus*	Laterally rotates thigh
Calcaneal tuberosity	*Triceps surae*	Plantar flexion

Table 8.1. Enthesopathies related to Rider's Syndrome after Baillif-Ducros et al. (2011:3, Table 1).

Anatomical areas	Joint changes
Acetabulum	Extension, elongation, and ovality
Femoral head	Iliac impression
Spine, acetabulum, MTT I, fovea caput	Osteoarthritis
Thoracic spine	Spinal dystrophy of growth, Scheuermann's disease (*Kyphosis*)
Lumbar spine	Lumbar hyperlordosis

Table 8.2. Osseous Changes Related to Rider's Syndrome after Baillif-Ducros et al. (2011:3, Table 2).

Rider's Syndrome (RS hereafter) is typically characterized by EC of the pelvis, femur, patella, and calcaneus, and DJD of the spine and the coxo-femoral joint, including the elongation (or ovalization) of the acetabulum. Various authors also highlight *Poirier's Facets* (Figure 8.4), also called the "reiterfacette" or iliac impressions on the femoral head (included in DJD of the hip), and *Schmorl's Nodes* (included in DJD of the spine) (Figure 8.5) as likely related to riding. "Poirier's Facet is scored as present when there is a noticeable, however slight, bulging of the articular surface of the femoral head toward the anterior portion of the femoral neck. This facet is necessarily smooth and is not to be confused with plaque formation" (Finnegan and Faust 1974:370). Schmorl's Nodes are herniations of the nucleus pulposus of the intervertebral disc into the adjacent cartilaginous end plate of the vertebra (Schmorl and Junghanns 1971). These result in a visible defect of a smooth-walled lesion on the superior or inferior surfaces of the involved vertebral body (Dar et al. 2009; Faccia and Williams 2008).

Figure 8.4. Poirier's Facet (Baillif-Ducros et al. 2014).

Figure 8.5. Schmorl's Nodes.

The *linea aspera* of the femur has also been identified as of particular interest in RS, and even described by some as the most important feature for the osteological identification of riders (Larentis 2017:105). "In intensive horseback riding for instance, the linea aspera on the femur can become very pronounced" (Capasso et al. 1999:104). Lastly, changes to the femoral-pattelar joint, and perhaps exotoses of the calcaneus, have recently been identified as related specifically to

stirrup use (Baillif-Ducros and Mcglynn 2013; McGlynn et al. 2012; Novotny et al. 2016). Elongation of the acetabulum is of particular interest to this study and will be discussed further below after the case studies are presented.

Case Studies of Riding in Archaeological Populations

Angel (1982) found adductor exotoses (in clinical literature often called rider's bone or rider's spur) in two cowboys he evaluated. Miller and Reinhard (1991) documented the effect of riding on the Omaha and Ponca of the Plains of North America after horses were reintroduced by the European invasion of the early 18th century. Miller (1992) reported that typical features of riders included expansion of the acetabulum and more developed insertion points for the hip flexors and adductors. Reinhard et al. (1994:72) thus identified habitual riding by "the presence of superior elongation of the acetaulum, extension of the articular surface of the femoral head onto the femoral neck, and enlarged muscle attachments for the gluteus medius and gluteus minimus, the adductor magnus and brevis, the vatus lateralis, and the medial head of the gastrocnemius muscles". They showed that DJD and trauma was substantially higher in male Omaha and Ponca due to riding.

Pálfi (1992) also found activity-induced skeletal markers indicative of riding in a sample of a 10th century Conquest Period population known to be equestrian archers buried with horses from the Hungarian Sárrétudvari-Hizófold cemetery, and cautioned that hyperostoic disease may hide such markers. Pálfi and Dutour (1996) expanded on this study and found "lesional unity" of riders in fourteen of their individuals centered on the hips and femurs (Figure 8.6). They report that the proximal femurs had hypertrophic insertions of the gluteus medius and maximus, adductor

magnus and brevis, and the quadriceps femoris and pectineus. Furthormore, the femoral head often extended onto the femoral neck and there were marked Poirier's Facets. At the distal femur, the insertions of the lateral and medial gastronemius muscle and the adductor magnus were well marked. In the innominates, they document superior exension of the acetabulum and hypertrophic insertions of the gluteus medius and maximus, adductor magnus, biceps femoris, semimembranosus, and semiteninosus. Lower limb fracture was also common as was DJD of the thoracolumbar and lumbar spine.

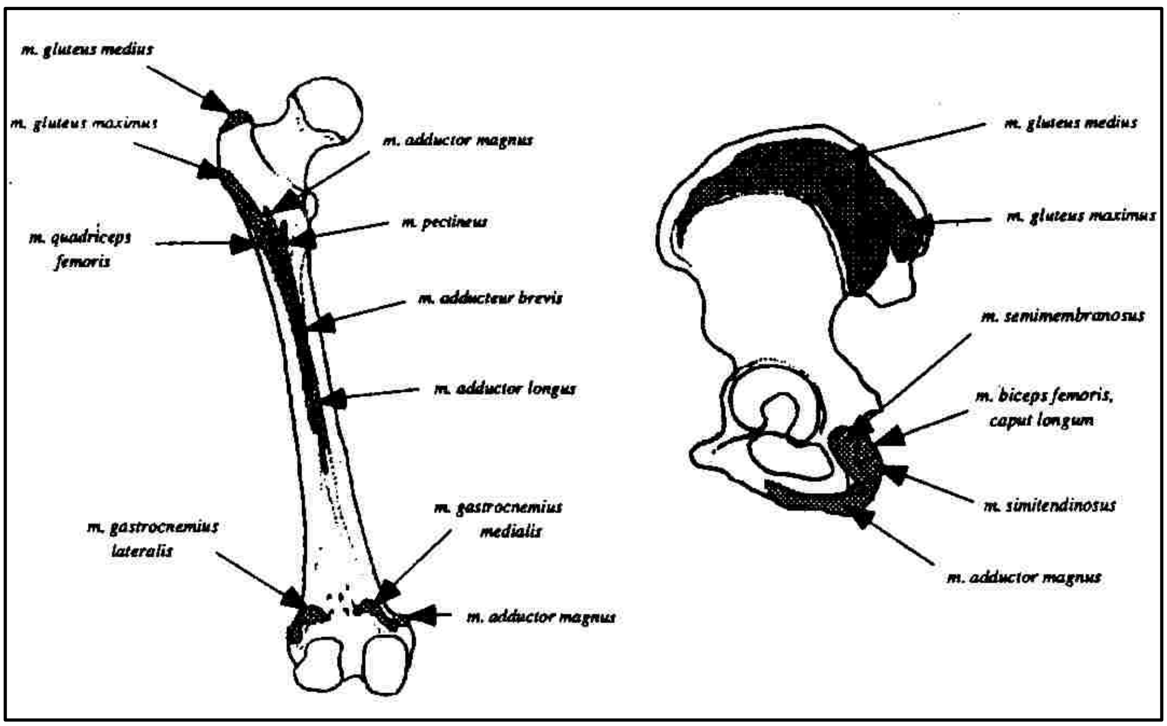

Figure 8.6. Locations of Entheseal Changes (EC) Related to Riding, as Identified by Pálfi and Dutour (1996:32, Fig. 10).

Blondiaux (1994) established a number of EC of the femur that characterize habitual riding based on French cavalry records (Molleson and Blondiaux 1994). "These include hypertrophied ligament attachment areas around the fovea of the femur, the hypotrochanteric spur in the greater

trochanter, as well as a pronounced linear aspera which supports attachment of the muscles that a rider uses to grip the back of the horse" (Molleson 2007:19). Molleson and Hodgson (1993) also identified a charioteer from the Royal Cemetery of Ur, based in part on pronounced attachment areas on the knees for the cruciate ligaments.

Blondiaux (1988) suggested that trochanteric spicules and gluteal and adductor exotoses together were suggestive of habitual riding. Blondiaux (1994) then described perifoveal osteophytosis, marked EC on the trocherantic fossa and linea aspera, DJD of much of the spine, and fractures of T7 and T11of a 5th century Hunno-Danubian woman who was likely a rider. At Kish, Iraq, four individuals dating from 2750 BC and in range from 2500-500 BC are reported by Molleson and Blondiaux (1994) to have strongly developed linea aspera, two of which also have EC of all three gluteal muscles on the greater trochanter, and one of which has a spicule in the trochanteric fossa at the insertion of the obturator internus and a Poirier's facet.

Buzhilova (2010) reported DJD of the shoulder (glenohymeral), elbow (cubitis) and hip (coxofemoral) joints and spine and EC of the femur, tibia, and ankle in known riders of the early Medieval Saltovo-Mayatskaya culture of the Pontic steppe. Expanding on this, his extensive comparative study, in an effort to identify the appearance of riding in the Eurasian steppes, found RS in LBA populations. Buzhilova also interestingly provides evidence that riding position varies by cultural affiliation, and such differences may be seen osteologically.

In burials of horsemen (people buried with horses, tack, and weapons) from the early Middle Ages in Italy (10th century) Belcastro et al. (2001) report that entheses of the hip, knee, and foot in males are all more developed compared to females. There were well-developed expressions of the anterior iliac imprint and vastus medialis only in males, with more obvious EC of the

iliopsoas and glueteus maximus. They identify the appearance of Allen fossa and the anterior iliac imprint as related to heavy hyperflextion of the hip in males, and related to riding. The throcanteric fossa and the EC of the external rotators (obturatorius internus and exturnus) are also highlighted as probably related to riding.

From the Medici Project, "The skeleton of Ferdinando I (1549-1609), 4th Grand Duke of Tuscany, revealed a vigorous man with skeletal age of 55-65 years and stature of 1.73 m. The muscular insertions are those of a very strong man; the skeletal markers associated with habitual horseback riding (lumbo-sacral arthritis; ovalisation of acetabula; hypertrophy of femoral rectum muscle; strong hypertrophy of the femoral biceps, great adductor, small gluteus, gluteal tuberosity, lateral vastus and gastrocnemius; osteophytosis of the femoral head and fovea and trocantheric fovea) are almost all present, and confirm his reputation of a fine horseman" (Fornaciari 2006).

Üstündağ and Deveci (2011) report that a 13-14th century burial of a young adult female from Akarçay Höyük in Turkey buried with a horse had thoracic kyphosis (with wedge shapped T4, T5, and T6 with Schmorl's nodes and anterior extensions on these vertebral bodies) [they suggest may be Scheuermann's disease], elongated acetabula, femoral enthesopathies, compression fracture on T-12, and evidence of traumatic anterior disc herniation. Huelga-Suarez et al. (2016) describe EC on 13th-14th century medieval skeletons from San Andrés de Arroyo, Spain that include insertions of the gluteus mussles, iliac psoas, and periofoveal osteophytosis and suggest that these markers identify these individuals as itinerant knights. Khudaverdyan et al. (2016) find a LIA individual from Shirakavan, Armenia to have an exceptional amount of trauma (including fractures of the ribs, face, and clavicle) and all expressions of RS described thus far, including an elongated acetabulum, strongly developed linea aspera with prounounced insertion

of all three gluteal muscles, spicule in the trocahnteric fossa, Poirier's facets, EC of the calcaneus, and DJD of the spine.

Karstens et al. (2017) examined 25 individuals from MBA Mongolia (1500-700 BC) and identified Schmorl's nodes and DJD consistent with studies of modern equestrians and identified a number of these individuals as riders because of these pathologies and the presence of horse burials in the region. Similarly, Eng (2007) studied DJD of the spine (including osteophytosis, apophyseal joint disease, Schmorl's nodes, and spondylolysis) in Bronze Age Mongolian pastoralists (2500-500 BC), Xiognu Empire (3rd c. BC – 2nd c. BC) mounted warriors, and Mongol Empire (13th – 14th c. AD) mounted warriors. Additionally, comparing sedentary peoples of the Chinese Empire to mounted nomadic pastoralists, Eng (2016) found injury rates and patterns among mounted nomadic pastoralists to be similar to those in the clinical literature for modern equestrians, especially cranial fractures in young adults, and reported a high incidence of hip arthritis among female nomadic pastoralists. Most recently, Fuka (Fuka 2018) examined 52 individuals in Bronze and Iron Age Mongolia (2500 BC – 200 AD) and identified EC that he attributed to riding in the hips and arms of individuals from the LBA/EIA, a claim supported by zooarchaeological and ethnoarchaeological research.

Diagnostic Markers of Rider's Syndrome

Baillif-Ducros et al. (2011) advocates for a strict protocol of RS, due to the lack of synthesis in the definition, based on six adult (20-29 years) skeletons from the 6th and 7th century buried with equestrian artifacts. They use data from the medical records of the riders of the famous Cadre Noir de Saumur to establish Equestrian Activity Indices (Indices d'Activités Équestres: IAE) located on

the spine and the coxo-femoral and femoral-patellar joints. They highlight three areas considered to be the strongest IAE: the ratio of the height (VEAC) to the width (HOAC) of the acetabulum of greater than 1:1; the presence of Poirier's Facets; and marked DJD of the knee, with a "collar" on the contour of the superior patellar surface of the distal femur.

Using EC and DJD to reconstruct past human activities, such as riding, is not without controversy. Both EC and DJD have complex, multifactorial etiologies where age, sex, genetics, weight, activity, and trauma all play a role (Waldron 2009; Weiss 2003; 2004; Weiss and Jurmain 2007). Recently, caution has been levied in activity studies of human remains because of the complex, multifactorial pathogeneses that result in osseous changes and a poor understanding of how much of the duration, frequency, and mechanical loading of certain activities will be marked in bone. "Looking at the overall trends…there is no support to enable the simplistic assumption that OA [DJD] derives directly from habitual activity" (Jurmain et al. 2012:534). However, Calce et al. (2018:45) report, "Variation in OA can be explained by age, stature, body mass, and structural adaptation related to habitual use" and multiple lines of evidence must be used in interpreting skeletal remains. Those articulating the suite of pathologies now being regularly termed as RS have all stressed that the coupling of a particular EC or expression of OA to riding is problematic. Hence the recent efforts have been to identify as many possible EC that may be related to riding in single cases of individuals from known populations of riders, often buried with horses or horse tack (Baillif-Ducros and Yvinec 2015; Djukic et al. 2018; Huelga-Suarez et al. 2016; Khudaverdyan, Khachatryan, and Eganyan 2016; Larentis 2017; Pálfi and Dutour 1996; Reinhard et al. 1994; Üstündağ and Deveci 2011). This makes the identification of RS more secure.

However, when dealing with archaeological populations where riding was practiced by few individuals, less intensively, or in those populations where riding has not been confirmed yet, using EC or DJD to identify riding is less secure. Pietrusewsky and Toomay-Douglas (2002) report that in a sample of African femora, a Poirier's facet was noted in 51-70%, an Allen's fossa was present in 14-32%, and a plaque formation was found in 20-25%. Poirier's facets exist in population that did not ride so identifying riding in an archeological population based on them is not supported. DJD of the spine (including Schmorl's nodes), hips, and knees are not specific to riders. Strongly developed EC on the femur or pelvis are also known from other activity patterns. Even if an individual had all of these osteologically visible changes to the pelvis and femurs, without supporting data (such as horse related grave goods or a related horse burial), characterizing them as riders would be premature at best.

There is only one osseous change that all authors apparently agree is distinctively caused by habitual riding, *and* as of yet, no other activity that accounts for this skeletal pathology has been put forth: the elongation or ovalization of the acteabulum (Baillif-Ducros et al. 2011; Baillif-Ducros and Mcglynn 2013; Baillif-Ducros and Yvinec 2015; Belcastro and Facchini 2002; Berthon et al. 2018; Courtaud and Rajev 1998; Erickson, Lee, and Bertram 2000; Fornaciari 2006; Khudaverdyan, Khachatryan, and Eganyan 2016; Larentis 2017; Miller 1992; Pálfi 1992; Pálfi and Dutour 1996; Reinhard et al. 1994; Üstündağ and Deveci 2011). Although the change is in the morphology of the shape of the acetabulum, it may or may not be related to DJD.

> Its ovalitzation is attested by everyone as subjects designated as probable horsemen. The relationship between ovalization of the acetabulum and riding has been studied in detail by Erickson et al. These authors have shown that the acetabulum feels at its anterosuperior edge a stretch upwards in the population that has contact with the horse.

> Son ovalisation est attestée pour chacun des sujets désignés comme de probables cavaliers. La relation entre l'ovalisation de l'acetabulum et la pratique cavalière a été étudiée en détail par Erickson et al. Ces auteurs ont montré que l'acetabulum présente au niveau de son bord antérosupérieur un étirement vers le haut chez la population en contact avec le cheval (Baillif-Ducros et al. 2011:3).

As rider biomechanic studies have demonstrated, the unusual position of the rider places unique demands on the pelvis at the coxo-femoral joint, and it is the literal seat of riding. Along with the action of the muscles listed above in Table 8.1 (especially the hip flexors, adductors, and rotators), the demands of the ligaments of the coxo-femoral joint (the iliofemoral, pubofemoral, and ischiofemoral) in riding pull the shape of the acetabulum along its anterosuperior border, which results in its ovalitzation or elongation. The acetabulum "has been reconsidered as one of the most important areas to determine if the individual has been horse riding…the ovalization of the acetabular region, together with the modification of its superior border, may indicate a subject devoted to horse riding" (Larentis 2017:105).

Erickson et al. (2000:474) describe the paucity of studies about markers of occupational stress (MOS) in equestrians: "Of the many occupations and habitual activities that affect the human skeleton, the MOS of frequent horseback riding have not been studied extensively". EA was first described in populations of *known* equestrians. In a study of Omaha and Ponca populations, Reindhard et al. (1994) were the first to describe the elongation of the acetabulum as a possible marker for habitual riders. Pálfi and Dutour (1996) also described EA in Hungarian horseman. Because of its uniqueness in specifically discerning riding, Erickson et al. (2000) conclude that the elongation of the acetabulum should be evaluated to test its potential as an MOS. The authors utilized a Fourier analysis, in which digitized outlines of acetabular rims are compared, to evaluate acetabula from two separate Arikara populations-one riding (Leavenworth) and one nonriding

(Larson). Similar conclusions to Reindhard et al. can be drawn as the "Leavenworth acetabula have expanded anterior-superior rims relative to Larson acetabula. . . Horseback riding is one major difference between these populations and, therefore, a likely source of the differences in acetabular morphology." (Erickson et al. 2000:479). The results of this analysis are significant for archaeologists studying horse-riding cultures. The authors conclude,

> A precise acetabulum MOS associated with horseback riding would be a useful tool for biological anthropologists. For example, if horses were known to be present in a population, but their use as mounts uncertain, such a MOS could discriminate between instances of mounted transportation vs. use only for draft and labor. Similarly, the sex or age of the most frequent riders within an equestrian group can be ascertained. In addition to the report of fractured calcaneus bones by Angel (1982) and the description of vertebral pathologies by Scott and Willey (1997), the rider's acetabular shape, as indicated by Fourier coefficients *B*2 and *B*4, could potentially be used to evaluate horse usage in other populations (Erickson et al. 2000:479).

Berthon et al. (2018) just confirmed the validity and reliability of using the ovalization of the acetabulum for identifying riders as this dissertation was being submitted in a study of 10th Century Hungarian mounted archers. Those buried with horses and tack had more markededly ovalized acetabulum. They measured the acetabulum following the Baillif-Ducros et al. (2011) methods I outline below with strict protocols to ensure reliability and reduce intraobserver error.

In sum, habitual riding marks the skeleton of the rider in several ways that can be discerned archaeologically. Elongation of the acetabulum may be the best single diagnostic marker of habitual riding in archaeological populations and thus is the focus of my analysis. This, coupled with DJD of the spine and EC of the pelvis and lower limbs, may be the best indicators of habitual riding. Fractures of the upper trunk, arms and hands, legs and feet, and face are also likely indicative of equestrian activity when present in individuals with elongated acetabula, DJD of the spine, and EC related to the muscles used in riding.

Methods and Materials for Identifying Riding in Bronze Age Hungarian Skeletons

Two hundred and two specimens (202) were examined for habitual riding from the following cemeteries, housed in the collections of the Magyar Természettudományi Múzeum (Hungarian Natural History Museum): Tiszavasvári-Deák Halom-Dűlő (Neolithic 5000-4500 BC, N=5), Tiszafüred-Majoroshalom sections B and D (MBA Füzesabony, N=50), Gelej-Kanális Dűlő (MBA Füzesabony, N=6), Érd-Hosszúföldek (MBA Vatya, N=11), Tiszafüred-Majoroshalom sections C and E (LBA Tumulus, N=15), Mezőcsát-Hörcsögös (LBA Tumulus, N=13), Jánoshida-Berek (LBA Tumulus, N=6), Solymár (Avar 568-800/850 AD, N=29), Sopronkőhida (Avar, N=32), and the Tiszavasvári combined sites (Avar, N=35) (Figure 8.7). The Neolithic site of Tiszavasvári-Deák Halom-Dűlő was used as a control for non-riders, as horses are not present in Neolithic Hungary. The Avar period sites were selected as a control for known riders as they are cemeteries from a population of documented riders, often buried with horses and tack, and have institutionalized social stratification (Noche-Dowdy 2015; Vida 2003). Mature adult specimens of both sexes were selected from the larger collections if the pelvis was in good enough preservation to measure the acetabula.

Figure 8.7. Map of Cemeteries Used in Study (Google Maps 2018).

Sex and age at death were determined, pathologies scored, and measurements of the femurs were recorded according to Buikstra and Ubelaker (1994). EC were recorded according to Hawkey and Merbs (1995). DJD and EC were simplified to presence and absence for comparison. Probable riders were determined based on changes in acetabular morphology established as diagnostic for habitual riding by Baillif-Ducros et al. (2011), just tested and substantiated by Berthon et al. (2018). Vertical acetabular diameter (VEAC) and horizontal acetabular diameter (HOAC) were recorded following Braüer (1988) as outlined in Baillif-Ducros et al. (2011:7) to establish a height/width ratio. According to Baillif-Ducros et al. (2011:9, Table 3, Figure 8), a height/width ratio of greater than 1.11 for R acetabula and 1.07 for left would indicate a probable rider. Femur length was used to normalize differences in size.

Results: Probable Riders in Bronze Age Hungary

Probable riders (PR) were first established based on the ratio of VEAC to HOAC (RVH) of the acetabula from the MBA cemeteries of Tiszafüred-Majoroshalom and Érd-Hosszúföldek, the LBA cemeteries of Tiszafüred-Majoroshalom, Mezőcsát-Hörcsögös, and Jánoshida-Berek, and the Avar period cemeteries of Solymár, Sopronkőhida, and Tiszavasvári combined (Table 8.3, Figures 8.9 and 8.10). None of the individuals from the Neolithic cemetery of Tiszavasvári-Deák Halom-Dűlő or the MBA cemetery of Gelej-Kanális Dűlő had a sufficient RVH to suggest they were riding. I further restricted the RVH to ≥ 1.12, identified as an extreme examples of RVH of riders by Baillif and Ducros et al. (2011:9, Figure 8) and found that many of the individuals in the above populations identified as PR maintained this more extreme anterior-superior elongation of the acetabulum (EA) (Figure 8.8). The absence of riders at Neolithic Tiszavasvári-Deák Halom-Dűlőand the presence of probable riders from all Avar cemeteries suggest that presence of probable riders in the MBA and LBA is very likely. The individuals from the MBA with RVH indicative of habitual riding are the first documented horseback riders in prehistory.

Period and Site	Median	Range Low	Range High	N	N≥1.10	%≥1.10	N≥1.12	%≥1.12
Neolithic Tiszavasvári-Deák Halom-Dűlő	1.019	0.998	1.076	5	0	0.00%	0	0.00%
MBA Füzesabony Gelej-Kanális-Dűlő	1.057	0.974	1.099	6	0	0.00%	0	0.00%
MBA Füzesabony Tiszafüred-Majoroshalom	1.081	0.943	1.242	49	19	38.78%	14	28.57%
MBA Vatya Érd-Hosszúföldek	1.116	1.095	1.139	11	10	90.91%	5	45.45%
LBA Tumulus Tiszafüred-Majoroshalom	1.094	1.071	1.276	15	6	40.00%	5	33.33%
LBA Tumulus Mezőcsát-Hörcsögös	1.122	1.058	1.183	13	9	69.23%	7	53.85%
LBA Tumulus Jánoshida-Berek	1.143	1.059	1.156	6	5	83.33%	4	66.67%
Avar Tiszavasvári	1.056	0.957	1.171	35	5	14.29%	3	8.57%
Avar Sopronkőhida	1.075	0.976	1.202	29	12	41.38%	9	31.03%
Avar Solymár	1.084	1.032	1.162	32	11	34.38%	7	21.88%

Table 8.3. Median and Range of RVH of Probable Riders (PR) with Number and Percentage of PR by Period at ≥ 1.10 and ≥ 1.12 Levels.

Figure 8.8. Example of Probable Rider with an Elongated Acetabulum (EA) from a Female of the MBA Cemetery of Füzesabony Tiszafüred-Majoroshalom.

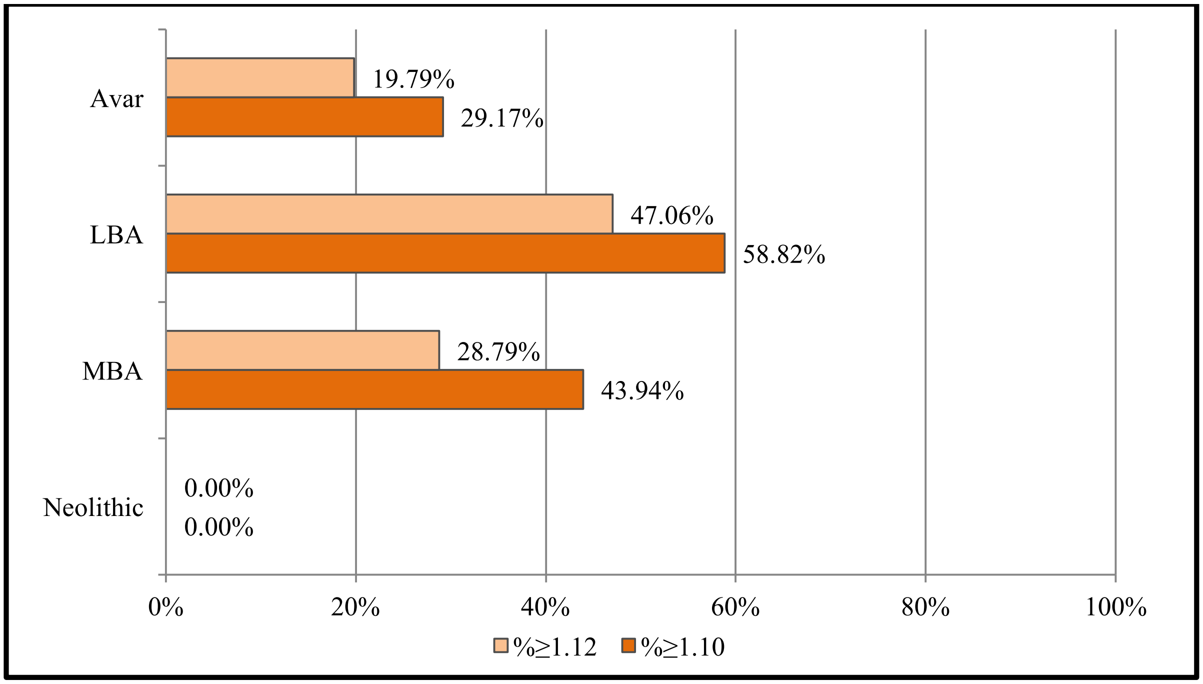

Figure 8.9. Probable Riders (PR) by Period from RVH of Acetabula at ≥ 1.10 and ≥ 1.12.

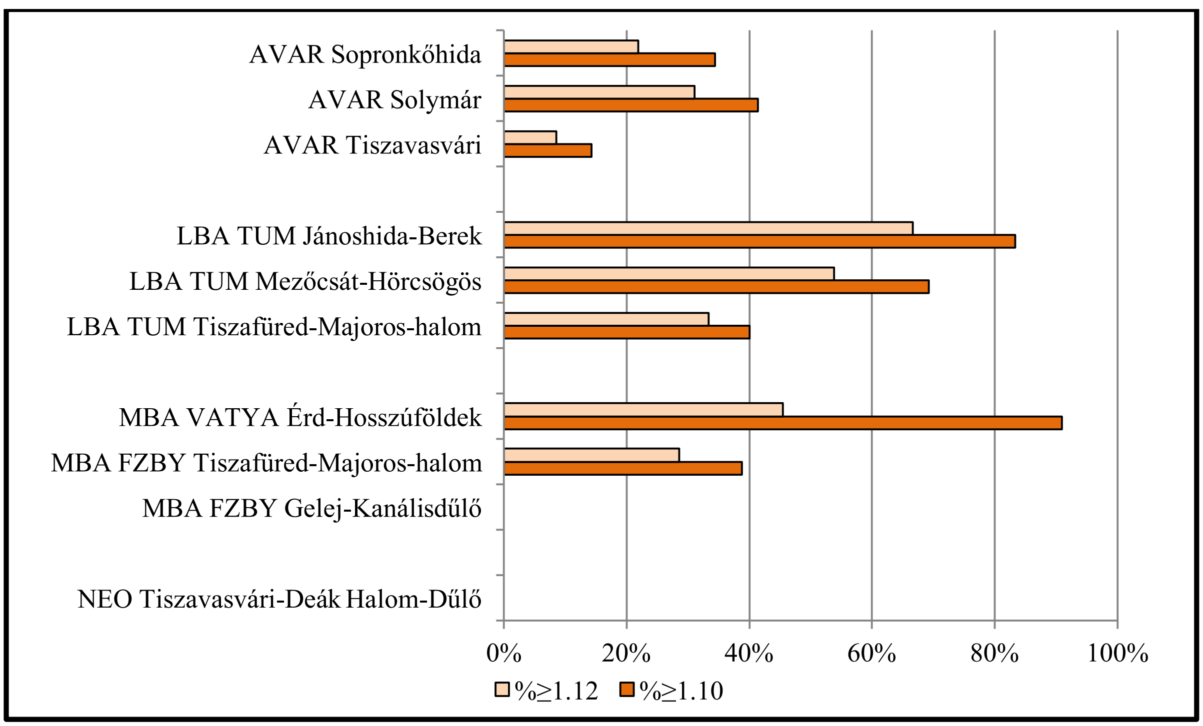

Figure 8.10. Percentages of Probable Riders (PR) by Site and Period by RVH of Acetabula at ≥ 1.10 and ≥ 1.12.

Neither DJD of the spine or appendicular skeleton varied with EA as established by RVH at the ≥ 1.10 level (Table 8.2). EC to the linea aspera and glueteal lines of the femurs did not vary at all with EA and did not vary with the presence of EA at either RVH level. However, at the 1.12 RVH, incidence of DJD of the spine and EC of the femurs were more likely. The higher the RVH, the greater likelihood that DJD and EC were present. This is probably why in many of the cases documented in the literature above showed a both EC and DJD with EA (and also fractures). Most of these cases were quite severe examples of RS, and the individuals were from known populations of equestrians interred in burials that included horses and tack. DJD of the spine was a better predictor than EC, but Schmorl's Nodes were present both within probable riders and in non-riders. The few Porier's Facets documented were in non-riders and in probable riders. DJD and EC were present throughout the sample population at each cemetery and the correlations were not particularly strong between EA RVH at ≥ 1.12, and not statistically significant at the ≥ 1.10 RVH level.

There were very few fractures (N=10) in the entire sample, but they were also more likely to be incurred by riders in each population (Table 8.4). The fractures of riders were those common to modern riders, most often occurring in falls. These included healed fractures of the clavicle, R and L femurs (in three separate individuals) at MBA Tiszafüred-Majoroshalom, fractured rib at LBA Jánoshida-Berek, and a fractured clavicle at Avar Sopronkőhida.

Cemeteries with PR	Fractures in Population	Fracture in PR @ 1.12	DJD Spine in Population	DJD Spine in PR @ 1.12	EC in Population	EC in PR @ 1.12	Metal in Burials	Metal in Burials of PR @ 1.12
MBA ÉRD	0.00%	0.00%	72.73%	40.00%	45.45%	20.00%	0.00%	0*
MBA TM	10.00%	***21.43%***	54.00%	***57.14%***	18.00%	***35.71%***	2.00%	0%
LBA MH	0.00%	0.00%	42.86%	***71.43%***	14.29%	***14.29%***	14.29%	***28.57%***
LBA TM	0.00%	0.00%	66.67%	***100%***	13.33%	0.00%	13.33%	***20.00%***
LBA JB	33.33%	25.00%	50.00%	***50.00%***	16.67%	***25.00%***	16.67%	***25.00%***
AVAR SM	0.00%	0.00%	72.41%	70.00%	27.59%	***40.00%***	6.90%	0.00%
AVAR SK	6.25%	***20.00%***	75.00%	***100.00 %***	40.63%	0.00%	6.25%	0.00%
AVAR TV	2.86%	0.00%	25.71%	***33.33%***	20.00%	***33.33%***	5.71%	0.00%

Table 8.4. Rates of Fracture, Degenerateive Joint Disease (DJD) of the Spine, Entheseal Changes (EC), and Metal in Burials from Each Cemetery with Probable Riders. Bolded and Italicized Numbers Highlight where PR score higher than the General Population. * MBA Érd had Animal Bone with Mass Burial.

Riding was likely not restricted by class or by sex in the MBA, but was apparently rather widespread and heterogeneous in practice at different tell settlements (Figures 8.11 and 8.12). The Avar period offers a comparison of the MBA and LBA to a society with a strict institutionalized social stratification and gender division, where horses are distinctly important in these divisions and in burial and in the political economy (Baron 2018; Bede 2012; Bökönyi and Vaday 1996; Marković et al. 2015; Noche-Dowdy 2015; Szõke 2003; Vida 2003; Vukičević et al. 2017). While Avar peoples are known to have a class of elite warrior equestrians, there are less of both sexes riding in these polities than in Bronze Age cultures. The Avar percentages of women riding drop significantly in comparison to men. Restriction of riding or horse usage by class is also apparent, as fewer people overall and fewer men are riding. This speaks to a restriction of riding by class

and sex as horses were critically important to the political economy and in warfare. The same pattern is not supported by the PR of the Hungarian Bronze Age. Men and women were both riding in significant numbers. The few burials with metal in my sample are not restricted to the PR, except in the LBA, perhaps because bronze was more widespread or because the equestrians were controlling the bronze trade. The samples are way too small to make any strong assertions either way.

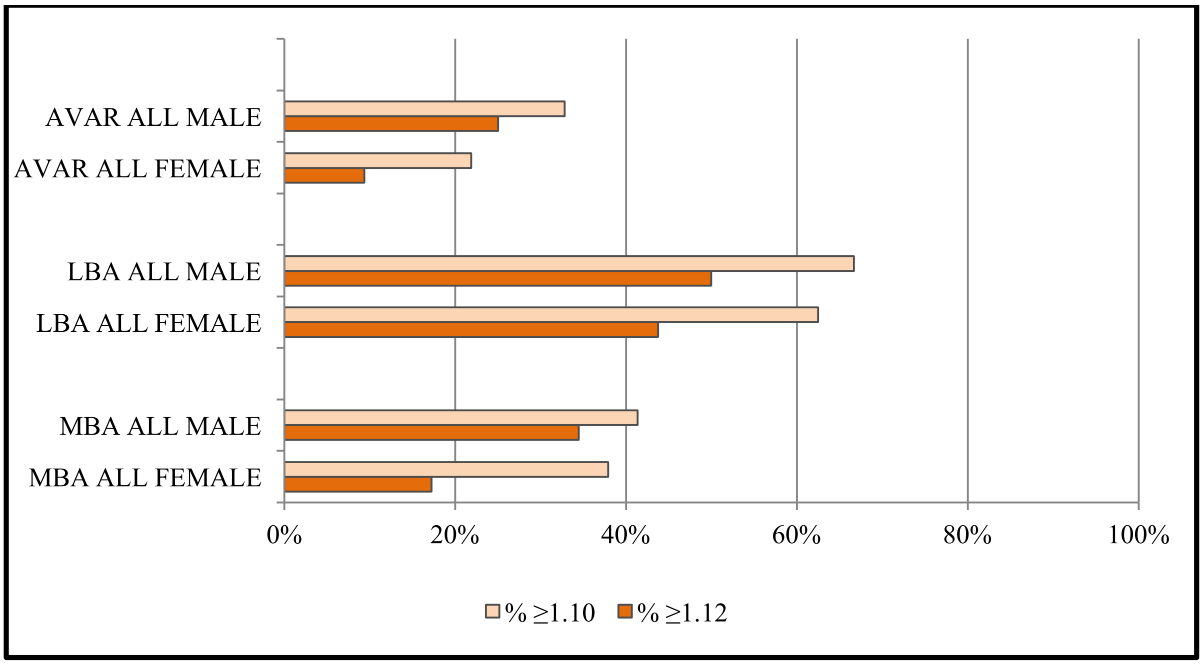

Figure 8.11. Probable Riders (PR) by Period Pooled Cemeteries and by Sex at RVH at ≥ 1.10 and ≥ 1.12.

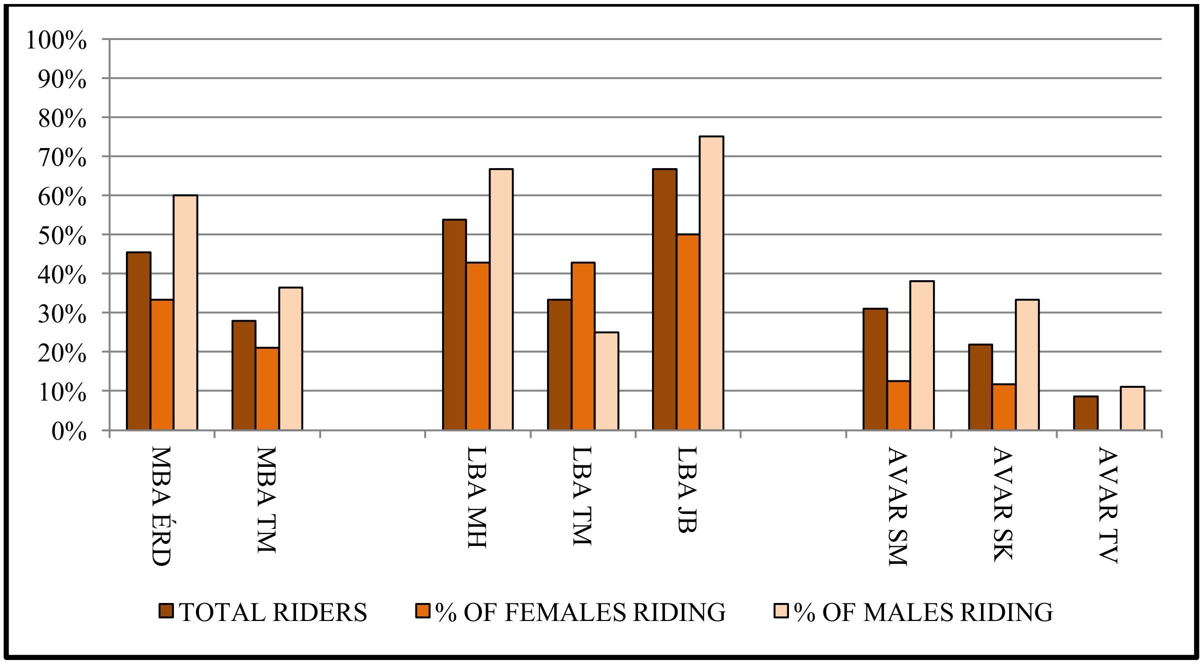

Figure 8.12. Percentages of Probable Riders (PR) by Cemetery Where PR Were Present at the ≥ 1.12 RVH Level. Percentages of Females and Males as PR Were Established from the Number of Each Sex Present in the Sample.

In the MBA, I suspect that riding was important to the herding of livestock. Ethnographic comparisons would suggest that young people of both sexes were tasked with herding, and that adults of both sexes rode when livestock husbandry facilitated by herding on horseback was a central subsistence practice (Kanne 2006). Horses were probably also key to the widespread travel suggested to have occurred in the Hungarian Bronze Age, and this is supported by the isotopic data (Chapter 6) where some horses at Százhalombatta-Földvár and the Gyulavarsánd tells have been imported from outside the Carpathian Basin.

The relationship of riding, or the conscription of it, to an elite male warrior class is not demonstrated by the data in my sample. There is no clear evidence that the riders were of an elite class either by health or by burial goods. Evidence of warfare is not present in the Bronze Age PR in my sample. The few fractures recorded in my sample are all common to falls from horseback.

Warfare and violence are not common in the MBA of Hungary (Szeverényi and Kiss 2018; Ubelaker and Pap 1996). The role of and importance of horses to the development and growth of the political economy may have been in travel, perhaps in the transport of metals, and in the maintenance of livestock. However, there is not any clear connection of horses in the development of a class of male elite warriors. This development was more probable at the very end of the LBA and into the EIA when new forms of equestrian burials appear for the first time.

There was heterogeneity in the practice of riding, as common to most aspects of MBA tell life, evidenced by no riders present at Gelej-Kanális Dűlő and an overwhelming majority of riders present at Érd-Hosszúföldek. The individuals from MBA Érd-Hosszúföldek were recovered together in a mass grave, but not connected to a single event like an attack, but were probably the result of a longer tradition of ritual acts (Hajdu 2006; 2008; 2009; 2012; Pap et al. 2008; Szeverényi and Kiss 2018). Several of these individuals may have been bound before burial, one juvenile female of 14-16 years of age and a 4-5-year-old child had perimortem skull injuries (not included in my sample due to unfused acetabula in juveniles), and several of the adults exhibited poor health with signs of infection, disease, malnutrition and physical stress (Pap et al. 2008). The majority of these individuals were riders; they have the highest rate of PR in the MBA sample. The settlement of Érd-Hosszúföldek was the largest flat (non-tell) settlement in the MBA polity related to Százhalombatta-Földvár. Is it possible that the individuals in the mass burial at Érd were interred differently than at the formal cremation cemeteries because they were horse people? They are not all foreign, as Pap et al. (2008) classify a number as Vatya. Why were these people singled out for this burial? The answers are not yet clear from my study.

By the LBA, with the advent of the Tumulus culture, mobility on horseback appears to be even more widespread and is confirmed by the settlement data and previous archaeological work. Previously, the Tumulus culture was thought to be an invasion of mounted warriors from the west, as many of the tells were depopulated at this time and population densities decreased. Now it is thought that was more likely a response to environmental degradation and social reorganization that led to a more mobile pastoralism and social organization with an open settlement network (Chapter 4) (Demény et al. 2017).

Recent anthropological study of these same LBA populations confirms the likelihood that MBA populations survived into the LBA (Hajdu 2012). The MBA Vatya are similar anthropologically to the LBA Tiszafüred and Great Hungarian Plain Tumulus peoples. My data demonstrate that a great number of both men and women were riding in the LBA in Hungary. The mounted Tumulus peoples probably developed from MBA equestrians. Mobility on horseback would have been a decisive advantage to this population continuity and in the social reorganization so obvious in the LBA Tumulus and later Urnfield period. LBA and EIA equestrian finds confirm that horses probably became a critical part of an emergent political economy in the terminal LBA (Urnfield) and especially in the EIA, where the first finds of more obviously elite male warriors were buried with horses and tack (Dular 2007; Metzner-Nebelsick 2002; 2007; 2017; Kmeťová 2013b; 2013a), although women were also buried with horses (Kmeťová and Stegmann-Rajtár 2014). The first evidence of mounted warfare was discovered at the LBA site of Tollense in Germany (c. 1250 BC), where men literally died on horseback. That these LBA mounted men were “officers” (Kristiansen and Suchowska-Ducke 2015:383) is not shown by the contexts or the osteological analysis (Jantzen et al. 2011; Price et al. 2017), but it is possible that they were.

The PR from MBA and LBA Hungary are probably the evidence of a slow increase in the adoption of equestrian practices, likely first introduced in the EBA. Horses were initially important in herding and protecting livestock and settlements, and in travel. They then became an essential part of emergent political economies in the very LBA/EIA as the need for a more mobile subsistence and social organization arose. The Avar period restriction of riding by class and sex would suggest that equestrianism throughout most the Hungarian Bronze Age largely was not a part of institutionalized social stratification or increased interpersonal violence or warfare. Although there are no LBA Urnfield peoples (mostly all cremated in Hungary) who reoccupied the tells or EIA individuals in my sample, the equestrian burials as described by Kmeťová and Stegmann-Rajtár (2014) from the EIA demonstrate that horses were both critically important to society and an expression of the high social status of the EIA Hallstatt elites.

Summary of the Equestrians of the Hungarian Bronze Age

This study has documented the earliest probable riders in prehistory from the MBA of Hungary. Riding was not evidently restricted by sex or by class in the Hungarian Bronze Age. This contradicts the idea that there was an elite class of charioteers or mounted male warriors at this time. There are no clear connections of riding or horses to chieftains or warriors or in control of the political economy. Riding in the Bronze Age was probably central to livestock management and protection and for travel. Its practice was widespread and heterogeneous in the MBA. Riding became even more common in the LBA Tumulus Period as horses were likely critical to a more mobile subsistence strategy and social organization. As horses and equestrians became essential to terminal LBA and Iron Age political economies and warfare, there usage likely became

restricted by class first and sex second. The Hungarian Bronze Age was the age of becoming equestrian. Horses became politicized in the process in the end phases. In the terminal LBA and the EIA, elite equestrian burials emerge that bespeaks the increased role of horses in the pursuit of power and control. The data from the Avar Period cemeteries show that when horses were embedded in the political economy, they were strongly connected and restricted to elite, warrior men, although women too continued to ride.

An additional task of this research was to pinpoint the most likely diagnostic osseous marker for riding, the elongation of the acetabulum (EA), and to confirm the validity of EA as a diagnostic marker for riding. No similar changes to the acetabulua were documented from a control population of Neolithic peoples who had no horses. EA was present in populations of known equestrians from the Avar period. These results substantiate the validity and reliability of EA as a diagnostic marker for habitual riding, as Berthon et al. (2018) recently confirmed using the same methodology.

CHAPTER 9

Synthesis and Conclusions: Becoming Equestrian

The goals of this dissertation were to evaluate human-horse relationships of the Hungarian Bronze Age using a political economy approach in the context of broader accumulative shifts of human and horse co-evolution through time. Integrating diverse lines of evidence and a wide range of methodologies, and incorporating recent revelations in human and horse population genomics, this research has resulted in a number of findings relevant for political economic theory, human-horse relationships, and a multispecies archaeology. It confirms many of the conclusions of earlier Hungarian and European research regarding the influx, dissemination, and importance of horses to peoples of Bronze Age Europe. These results also contrast and complicate earlier assumptions about how horses were used and who exactly was using them in this period, which in turn challenge a traditional Bronze Age narrative. This leads to new insights into the tell building communities of the Hungarian Bronze Age and into how people and horses co-constructed and profoundly altered history in new ways through time.

Results: Horses in the Political Economy of Bronze Age Hungary

To recap, if horses were important to the development of political economies in the Hungarian Bronze Age, their arrival and spread should be coincident with the origin and growth of the polities known from the period. Horses should be present in demonstrable numbers throughout Hungary. Their remains should be concentrated at central settlements. Horse husbandry should be oriented towards use related secondary products, namely riding or draught. Demographic profiles represented should demonstrate a population geared for use and exchange.

Use and production should be intensified through time with growing political economies. There should also be enough horses for use within polities and for exchange with external trading partners. Stable isotope analysis should confirm exchange at some distance occurred. Changes in the size or type of horses should also be evident if specialized production was pursued. Biometric measures of horse bones record if selection for size or type may have occurred. Such biometric measures will also indicate if the size of horses was adequate for riding.

With these practices, there should be concurrent changes in attitudes towards horses, reflecting the increased socioeconomic importance of horses. This should be observable in body part representation, cut marks, depositional practices, and tools made from horse bones. The presence and distribution of horse bits and their types should reflect this shift also and provide some evidence of how horses were used. Horse and human remains should provide the clearest indications of how horses were used. If horses were ridden, both their remains and those of the people that rode them should present osteological changes indicative of riding. If chariotry was important, skeletal changes in horses more obviously caused by pulling a chariot, and finds of chariots and chariot related weapons should be present.

Horse remains or bits should clearly be tied to an emergent elite warrior aristocracy through differential patterns in their deposition, placement in select human graves, or remains and bits found with weapons or bronze hoards. The human remains present the most obvious way to link riding to a specific class or sex as there should be patterns of institutionalized social stratification in skeletal pathologies related to riding. Equestrianism should emerge as an institution with the development of political economies in Bronze Age Hungary whereby horses, the ownership, control, use, and exchange were clearly linked to the warrior aristocracy. Warfare and ideological

correlates to the elite warrior institution, such as the décor on the bits and weapons and evidence of interpersonal violence, should further substantiate if horses were important to political economies and the suggested rise of warrior aristocracies throughout Eurasia.

First, in terms of the Hungarian Bronze Age, in conjunction with recent discoveries in human population and equine genomics, this study confirms the influx of domesticated horses and people in the LCA and EBA of Hungary, in all likelihood the result of Yamnaya migrations (Allentoft et al. 2015; Haak et al. 2015; Goldberg et al. 2017; Olalde et al. 2018). People probably rode horses into Hungary to herd their livestock in search of good pasturage, easy access to water, and new mates. From the earliest known horse domestication site of Botai in Kazakhstan (3500 BC), “The existence of three independent lines of bit-wear evidence provides a strong indication of control and possible riding of horses” (Gaunitz et al. 2018 supplement, original research in Anthony and Brown 2011; 1989; 1991; Anthony et al. 2006; Outram et al. 2009).

There were unusually large numbers of horses at EBA Bell Beaker – Csepel Group settlements in the Danube Bend. This, along with the age profiles of horses and an extraordinarily high numbers of horses per person support the idea the Hungary was a bridgehead for the dispersal of horses to the rest of Europe. Guanitz et al. (2018) further substantiate this idea beyond a reasonable doubt with the absolute dating of a horse from the late EBA/early MBA Nagyrév/Vatya site of Dunáujváros-Kosziderpadlás from to 2139 –1981 cal. BC that is ancestral to all domesticated horses. “This indicates that a massive genomic turnover underpins the expansion of the horse stock that gave rise to modern domesticates, which coincides with large-scale human population expansions during the Early Bronze Age” (Gaunitz et al. 2018:1). Long-term and incredibly significant migrations of people and horses and shifts in horse and human genetics

underlie the genesis of the Hungarian Bronze age. Local populations partnered with these migrants to form Bronze Age communities in Hungary. Horses were front and center in these developments.

As horses were dispersed during the beginning of the tell building cultures in Hungary, their numbers decreased but their presence was widespread. Conscription of horses to central settlements is hard to gauge, as there are simply not enough excavations of non-tell settlements to determine this. The numbers of horses at Bronze Age Hungarian settlements indicates that these populations provided enough horses for use (for herding, travel, and protection/raiding) with a modest amount available for exchange. While often dismissed as a low number in relative abundance in comparison to other taxa, the NISP % are also well within the range of numbers of horses maintained by historically known mounted equestrians from later periods in the region. Surplus production for use and exchange was highly likely from the EBA BB-Csepel group settlements, while small-scale surplus production in horses was possible from most MBA settlements in Hungary.

The $^{87}Sr/^{86}Sr$ stable isotope analysis confirms that some horses were indeed exchanged from great distances during the MBA. Most of the horses from Százhalombatta-Földvár were grazed locally as they matured, but there were several mature adult outliers that were obtained from a great distance, probably on the fringes of the Carpathian Basin. The stable isotope data shows that peoples from two of the eastern tells of the Berettyó Valley imported all of their mature, adult using animals from outside their local areas as well. They only had adult, imported horses.

People were breeding larger and more refined horses in the Hungarian Bronze Age. There was a significant 7.52 cm increase in the height of horses from the EBA to the LBA and the thickness (robusticity) of the lower leg bones decreased, while variance increased. Specialized

selection of horses could also be related to a desire to improve the comfort or performance of riding horses, as shown by the specific increase in pastern length. A proliferation of coat colors, and a subsequent burst of selection against particular coat colors, during the Bronze Age supports the idea of selective breeding of horses for particular colors and sizes, and potentially types (Librado et al. 2017; Ludwig et al. 2014; Schubert et al. 2014). Contrary to many early, and now outdated assumptions, horses were plenty big and sturdy enough to ride, and well within the size range of ancient Roman cavalry and modern ridden horses.

Breeding and use of horses was not apparently intensified during the Hungarian Bronze Age however, save the notable exception of Pecica-*Şanţul Mare* southeast of Hungary in Romania, where intensive horse production and feasting occurred just prior to a growth in metallurgical output. At most settlements, numbers of horses remained relatively stable or decreased through the MBA to the LBA, and those settlements with finer excavation detail do not indicate increases in horse production during the MBA. At Százhalombatta-Földvár, there were modest, but appreciable numbers of horses comprising a full breeding population, but missing some prime aged animals, with a few imports of prime aged horses from a distance. This polity demonstrates a probable small-scale but consistent household/kin centric model of horse breeding, training, use, and exchange, which is similar to the impressions given by pottery and other craft production traditions. This was likely the case for many settlements throughout the Hungarian Bronze Age, but regional heterogeneity was also strong for horse husbandry like other animal husbandry and craft practices.

Cultural attitudes towards horses shifted in many places as indicated by body part representation and dispositional practices, which contrasted with other domesticated animals. This

was probably related to their increased utility for riding the herds, travel, and protection of settlements. There were period and regional differences of these practices however. Body part representation, cut marks, and depositional practices suggest that people utilized both carcass (meat, bone, hide, etc.) and secondary products (riding and probably traction and milk) during the EBA. At MBA Vatya sites particularly, the use of horses for meat was probably not the goal of breeding, but even at these sites there were strong differentials in production goals. There was a full breeding population with many aged horses demonstrating the maladies of ridden horses at Százhalombatta-Földvár. At neighboring Vatya Királyok Útja 293, there was a concentration of younger animals but older animals were present and their osteopathologies also divulge evidence of their use as mounts and careful care after significant injury.

At the Gyulavársand tells in the Berretyó Valley, mature horses were apparently imported, as young animals are nearly missing from population profiles. They also show more evidence of high utility carcass product use after death. Pecica-*Şanţul Mare*, a Maros tell southeast of Hungary in Romania presents a quite different picture from the MBA tells of north central and western Hungary. This settlement had the highest number of horses during the MBA and unusual ritual deposits of horses likely related to feasting (Nicodemus 2014). Horses were apparently widely utilized for meat here, but the high numbers and demographic profiles strongly suggest that this site was a major center of breeding and exchange in horses, which peaked just before an explosion in metal trade and production there. Like the eastern tells in Hungary, the peoples of this polity may have retained more steppe like cultural attitudes towards and uses of horses due to their closer proximity and regular exchange.

The introduction and dispersal of horses into Hungary along with the apparent increase in importance of horses for riding was accompanied by the appearance of a new bit with rod shaped bit cheekpieces all over Hungary. Absolute chronologies and the bit finds underscore the unique origins and position of equestrianism in Bronze Age Hungary, which began in the EBA and expanded during the MBA. Domesticated horses were ridden into Hungary and riding became associated with rod shaped cheekpieces in the early MBA, from 2000 – 1700 BC. With the radiocarbon dating of the earliest basal domesticated horse from Dunaújváros-Kosziderpadlás, this can potentially be dated to 2139-1981 cal BC. Roughly 150 years later, a different tradition of equestrian practices is documented on the steppes, chariotry, and its use was associated with spiked, disc (and some rectangular) cheekpieces. Burials of chariots, horses, disc-cheekpieces, weapons and warriors were found at Sintashta settlements date between 1950-1750 cal BC (Chechushkov et al. 2018; Kuznetsov 2006). These are rather different burial traditions associated with different cultural contexts and uses. An increase in warfare is likely at the time of the Sintashta chariot burials. This degree of violence was virtually absent from the Hungarian Bronze Age. Human remains from this dissertation research and earlier studies show a strikingly low level of interpersonal violence. The very small amount of trauma on the skeletons in this study is consistent with falls from horseback, but they of course could have other origins. The first known battlefield in Europe, dating from 1250 BC at Tollense, Germany, at the very end of the LBA Tumulus period in Hungary, shows that a small group of people died riding. Chariots were not involved in this early warfare in central Europe.

The emergence of chariotry on the steppes may represent a way for these people who had used and ridden horses for several millennia to differentiate themselves socially and politically in

an increasingly competitive environment. The association of chariots with prestige and leadership accompanied its origins and dispersal from the steppes to the Near East, Egypt, Anatolia, and the Aegean. Genomic research documents some introduction of steppe genes to the Aegean at roughly the same time, which gave rise to the Mycenaean people (Mathieson et al. 2018). Chariotry was not mediated through Hungary at this time. The bits associated with chariots are not known in Hungary. Though the spiral motif shows the potential of some cultural contact, this design probably originated in Hungary and spread north and south with traders and travelers. The presence of chariots on the rock art of Scandinavia is more likely related to the now more precisely provenienced maritime bronze trade to the Aegean (Ling and Uhnér 2014). Ideas and imagery about chariots more likely came to Northern Europe via this route, rather than through Hungary. This makes better sense chronologically as chariots appear in imagery in both regions after 1500 BC, nearly two millennia after domesticated horses were ridden into Hungary.

Human remains, horse remains, the horse bits, horse age profiles, shifting cultural significance, and evidence of long distance exchange in horses all substantiate that horses were ridden during the Hungarian Bronze Age. Cattle or oxen probably pulled wagons. Chariotry was of little or no consequence in the region. A foreign import of this equestrian tradition was not related to the development of Bronze Age polities or political economies. Surprisingly, there is very little evidence that horses were ridden, owned, or controlled exclusively by an elite class or used by warriors. Rather, riding appears widespread and not restricted by class or sex, in contrast to later periods. Riding actually became more widespread from the MBA to the LBA Tumulus peoples. The first real evidence for a mounted, male warrior elite comes from the EIA, where men

were buried with bridled horses and weapons. In this period, women appear also with buried horses as well, as do people who may have been full-time grooms, caretakers or trainers of horses.

The horse-human relationships of the Hungarian Bronze Age were largely characterized by a goodly number of people riding horses to herd other livestock, probably protect livestock and settlements, and to travel. There are really no clear links between warriors, horses, and weapons. Horses were not obvious markers of social status or wealth. While identity may have been animated through horses, institutionalized social stratification was apparently not. Even though a fair percentage of the population were riding, a mounted warrior elite was not present at the genesis and florescence of the vast majority of the tell building polities of the Hungarian Bronze Age. Conscription of horses into political economies was spotty at best, with the polity of Pecica-*Şanţul Mare* southeast of Hungary in Romania the notable exception. Like Pecica, the eastern tells of Hungary may have retained more regular exchange with horse peoples farther east. Breeding for use and some low-level, but regular exchange of horses between cultural areas was apparently the norm. The bit traditions of the Hungarian Bronze Age were unique to the region and an autochthonous, widespread development.

Equestrian Implications for the Political Economy Model of Bronze Age Hungary

Horses complicate the picture of nascent political economies as envisioned by Kristiansen and Earle (2010; 2015). As a novel technological and social development, introduced in the LCA and in great numbers in the EBA, they should absolutely underpin developments of the hypothesized new levels of complexity in landscapes, settlements and economies of the Hungarian Bronze Age. Horses arrive under and with the Yamnaya, whose traditions of property, family, and

wealth Kristiansen and Earle (2010:20) consider foundational to emergent Bronze Age communities and political economies. Herding and protecting the large flocks of cattle and sheep on horseback was defining of the period. Distances between settlements, the organization of settlements in the landscape, and the organization of the majority pastoral subsistence economy makes sense when management is undertaken on horseback. Riding also greatly facilitated travel and exchange. Control of metals and trade routes along the Danube by a rising class of warrior elites is suggested to be characteristic of the Hungarian Bronze Age. Metal flows certainly increased with the introduction of domesticated horses and they very probably had much to do with obtaining and moving ores and finished products.

But horses are not clearly connected with a particular class of individuals or directly with warfare for all but maybe the very end of the LBA. The absence of horses in pursuits of political and economic power creates an interpretive problem. There is a significant tension between novel and important shifts in human-horse relationships that characterize the Bronze Age and the theorized incipient political economies. Horses do not appear to be directly involved on the one hand, on the other, *how could they not be*? If control of the political economy was a key pursuit of those desiring authority, then why weren't horses and their usage obviously controlled and aligned with rulers? They could have provided a controllable means to move metals, guard trade routes, and monopolize wealth. Their widespread and heterogeneous use with no clear restriction to ownership or use by class or sex suggests that they did not. Why not?

Emergent political hierarchies and a warrior elite in the Hungarian Bronze Age may be overstated, as envisioned by Earle and Kristiansen (Brück and Fontijn 2002; Frieman et al. 2017; Kienlin 2012; 2015; 2017; Kienlin and Zimmerman 2012). Horses could have facilitated a

resistance to overarching rule. Horse breeding and use was probably the domain of kin-based lineages engaged in animal agriculture. The long-lived, greatly peaceful Hungarian Bronze Age with people living well below the agrarian carrying capacities of their environs seems to have been a more communal enterprise with safeguards in place to subvert overt power grabs. The relations of agrarian production were diffuse in the society and not easily directed into political institutions of rule. If not desiring leadership beyond the lineage, horse people would have been incredibly difficult to control. Indeed, Jennings and Earle (2016:474) suggest that population aggregation of farmers and herders "may have served as a brake rather than an accelerant to central power".

Horses may have been essential in resistance to chiefly rule until they became part of the more extensive subsistence required in a reduced carrying capacity where decreased comparative advantages in production led them to be essential to rule. This didn't happen until the end of the LBA, c. between 1200 and 1100 BC when a steep decline in agricultural productivity further prompted population decentralization, and a renewed resurgence in more extensive forms of animal husbandry, especially east of the Danube (French 2010:47). These circumstances may have led to the later increased ownership and control of agricultural fields, and a need to fight for and protect landed rights over production. Coincidently, the battlefield of Tollense, Germany dates to 1250 BC. Unfortunately, due to the nature of the settlements, my research has a paucity of data relating to this period, save for the Tumulus peoples of the LBA, who exhibited an increase in the number of people riding. This would make sense in a world where a period of more extensive animal husbandry over less productive pastures, maintained via horseback, developed prior to the reestablishment of tell communities during the Urnfield Period.

With pastures giving way to crops, the LBA was a continuation of MBA animal husbandry practices, with added dispersal of animal grazing to higher pastures. The faunal distributions indicate similar relative frequencies of domesticates to the MBA. However, there is an increase in horses from the MBA to the LBA from some settlements with both occupations. Choyke (2005b) documents the importance of horses at Jászdósza-Kápolnahalom on the Great Hungarian Plain. Horse breeding and equestrianism continued and perhaps played a larger role in raiding and warfare by this period if Tollense is any guide. From the Late Urnfield Period (1050-800 BC), horse skulls were placed in graves in Eastern Hungary, and this practice continues into the EIA, where true graves of warrior horsemen are known (Kmeťová and Stegmann-Rajtár 2014:149).

Interestingly, 1000 BC is the date pointed by Anthony (2007), Anthony and Brown (2011), Kohler et al. (2017), Turchin et al. (2013; 2016) and Drews (2004; 2017) as the rise of cavalry. I would argue that cavalry was not necessary until this time, potentially because there was little impetus to aggregate to protect agricultural resources at a regional level, little competition for land, and there were not a terrible amount of comparative advantages to be gained in agricultural production in Central Europe until the LBA/EIA transition. I suspect there is a linkage to the amount of land under cultivation and the rise of coordinated mounted warfare to protect it. Indeed, in Hungary, at 1000 BC, animal husbandry became secondary to more intensive crop agriculture and millet cultivation became important (Gamarra et al. 2018). As Anthony and Brown (2011) suggest, the growth of cavalry was also probably related to the technological advantages of the recurve bow that could be carried on horseback easily. Arrowheads and quivers are present in the EIA horse warrior graves in Hungary.

Additionally, the states of the Near East and Egypt, supposedly great adopters of chariot warfare, had little need for the import and expense of a cavalry when infantry with some chariot support provided the military necessary for rule. Furthermore, although a potent symbol of power and rule, chariotry has been probably greatly overblown in number and real military importance given the surprising and incredible paucity of archaeological finds, review in Feldman and Sauvage (2010). It is only when the mounted warriors of Central Europe and the Steppes become greater in number, like those that the study documented during the Tumulus period, that the shift for cavalry begins in the states of the Old World.

In sum, this study provides some support for horses in a political economy model of Bronze Age tell building societies of Hungary via human-horse relationships. Horses did increase in number and spread at the beginning of the Bronze Age. They were specially bred and traded. New bit technologies were developed. But they were not obvisouly or widely incorporated into political economies. There was little evidence of elite control of horses or restricted riding. Horse or chariot riding warrior aristocracies do not appear to factor much into Bronze Age Hungarian societies. Dismounting the warrior elite from his horse, the results present a rather more complicated picture, which is in line with research that tested this influential model, and found less clear political centralization, social stratification, control of metal trade, and warrior elites (Duffy 2010; Polanyi 2018; Quinn 2017). However, continuing the trend of localized, heterogeneity in tell building communities, Nicodemus (2014) does find support for the model with horses SE of Hungary in Romania.

Earle and Kristiansen (2010:20) rightly point to two events that significantly shaped the European Bronze Age: the Yamnaya migrations, c. 3300 BC, and the influx of horse technologies,

c. 2000 BC (beginning of the MBA). Horses clearly were central to the genesis of these communities as they were ridden into Hungary with an influx of new peoples and new settlements in previously unoccupied areas. This set the stage for the dispersal of domesticated horses and people throughout Hungary at the beginning of the MBA. The horse at Dunaújváros-Kosziderpadlás that has been found to be ancestral to all domesticated horses dates to the beginning of the MBA. Special cheekpieces for bits appear everywhere at this time. Horses are exchanged at a great distance and their presence on tell settlements looks spatially to be related to the routes for ores in the Slovak ore mountains and the Alpines. Horses survive well in to old age in most places and their bones show pathologies consistent with ridden work.

However, chariotry was non-existent. Horse based warfare seems rare at best, and directed towards the end of the period, during a phase of clear agricultural degradation. Restriction of riding by class or gender did not happen in the Hungarian Bronze Age. There are no obvious ties to elites, warriors, or an international culture of institutionalized warrior aristocracies. The Hungarian Bronze Age was a long-lived and relatively peaceful period, with heterogeneity of animal husbandry practices and goals and craft production. Trade certainly occurred and was important. But strong mechanisms for resistance to chiefly control seem to be more probable at this point, if horses are any guide. Social stratification seems more related to age and skill than class. While animal husbandry practices were oriented more towards secondary products production, the production was not intensified during any period of the MBA, which limits an interpretation that commodities borne of animal production were ramped up to support the metal trade. Spindle whorl finds are very few to support textiles as a trade commodity, but raw wool may have been. Additionally, though animal husbandry regimes were variable across the tell building societies, *all*

tell building communities had the same livestock and household needs would have been easily met. Horses may have been used to move metals or to trade for them, but no one group or faction seemed to control this.

Earle (2017) agrees that the evidence for marked social stratification and hierarchal rule is limited for most of the Bronze Age in the Carpathian Basin. He suggests that this is because the previously so emphatically wealth financed chiefdoms, look more like corporately oriented polities as additional evidence is compiled, and in line with Blanton and Fargher's (2008) work on collective action theory. Conspicuous consumption and obvious wealth in burials would be less appropriate to display with this type of sociopolitical organization. The more chieftains depend on their agricultural communities for rule, the less likely they will be able to overtly exert and display power. Earle (2017:316) surmises, following Kienlin (2017),

> Unlike the stratified Aegean societies, no palaces or proto-urban settlements existed in tell-building communities. 'There is little evidence of social differentiation and/or political hierarchisation from both the Neolithic and Bronze Age tells'. Most researchers, including me, would agree with this position. The Bronze Age in the Carpathian Basin emphasized group (community) identity, as suggested by settlement arrangements and burial practice. This is in sharp contrast to the Aegean, and for that matter to the social stratification in Bronze Age Scandinavia, where Kristiansen has worked most extensively. Kienlin argues strongly that 'Early and Middle Bronze Age tell-"building" societies […] developed largely on their own' and not in response to ties with the Aegean world order"… Tell-building societies did not emphasise social hierarchy and were not primarily the outcome of world-system processes. These are convincing conclusions.

Moreover, Earle (2017:317–318) pushes chiefly control to the later Koszider horizon, 1600-1500/1450 BC, rather than earlier when the tells and other related communities were established and the hoards were buried.

> Kienlin's position that the characteristics seen in Bronze Age Hungarian tell-building societies followed practices that existed in the Neolithic traditions is correct, but it does not recognize adequately how the media of the practices created new sources of power. Although tells of both periods probably represent similar corporate patterns, what was

> owned appears to have changed from local agricultural lands only (in eastern Hungary) to agricultural lands and trade routes (along the Danube). Although hoards exist in both areas, control over wealth appears to have generated the pattern of hoards associated with the central places along the Danube. I would argue that corporate chiefs, controlling metal flows to some measure, were most probably important here at least during the Koszider horizon.

The political economy, and attempts to control it, appears to have developed at a slower pace, with less obvious hierarchical organization and social stratification, and little obvious incorporation of horses. The previous emphasis on a warrior aristocracy developing with the tell building cultures is missing from this most recent analysis. Perhaps the aversion to a more centralized governance was generated from the merging of Yamnaya immigrant populations and indigenous farmers, who aggregated as a means to organize animal husbandry and agricultural and craft production. These immigrants were thought to be on the move, not only because they had horses and wagons, but because they were perhaps escaping increased competition for land and partners in the context of increasing social hierarchy on the Pontic Caspian steppes (Anthony 2007). Bronze Age Hungary was certainly a land of plenty for animal and crop agriculture with its newly established rich pastures and productive fields. Leadership could have continued to be age and skill related, and kin-organized animal husbandry would have much to do with this organization. Perhaps this also had to do with the autonomous nature of horse riding peoples with a reluctance to centralized rule because of their very ability to elude and better resist challenges through mobility and fighting advantage on horseback. The societies were most certainly complex. I can say that human-horse relationships were largely not those of martial and political importance for most of the period in Hungary. However, at the very end of the period, this starts to change and the Bronze Age becomes the Iron Age. Why?

Warriors, horses, and weapons, were buried together in EIA Scythian burials and Hallstatt barrows in Hungary. The weapons that are found in this period, bows, arrows, arrowheads, maces, daggers, axes, and lances are those of mounted warriors. Wealth appears to be strongly tied to and reckoned in horses. These are the first real indications of the increased importance of horses in warfare. These burial practices may also reveal a more familiar and intimate relationship of a person to a single horse. A vibrant development of fancy material culture decorated with horses first appears in this period. Horses continue to be selected more clearly for type and for height and robusticity. Similar in form to bits from the Bronze Age rod cheekpieces, new bronze and then iron bits appear on the scene (Figure 9.1).

Figure 9.1. Boar Tusk and Bronze Bit from the Iron Age Hillfort at Százholombatta-Földvár (Visy 2003:187, Fig. 19).

In terms of sociopolitical organization, Iron Age Hallstatt communities built substantially fortified hillforts, like that of Százhalombatta-Földvár whose Iron Age rampart is still visible, along and at the junctions of major trade routes. Few Iron Age hillforts have been systematically excavated, but the indications are that there were more obvious signs of political centralization and social stratification as evidenced by the substantial defensive fortification, the internal settlement

structure, and major differences in socioeconomic status and wealth distribution in the burials. Horses figure prominently in burials, material culture, and art and have clear ties to warriors, weapons, wealth, and warfare.

The EIA in Hungary has what I expected to find in the Bronze Age of Hungary, if horses became as critical to political economies and increased warfare as suggested. However, my results show a rather different picture. Were horses politicized during the course of the Bronze Age? They do appear in warfare at the first major battlefield in the LBA. They were specially bred, grew in size, and were exchanged at some distance, perhaps along ore and metallurgical trade routes. But their widespread use by people of all social classes, men and women, preclude the idea that their use was specifically tied to a group of warrior elites. Until Tollense, there are few indications that horses were linked with much warfare, or that warfare was a significant concern of the Bronze Age populations in this study. They do not appear in burials and are not associated with weapons. Some houses at Százhalombatta-Földvár have horse bones in pits that may represent ritual deposits and caches of bits. However, at the same site, bits and concentrations of horse bones are found outside of houses in many different contexts, as is the case at most of the tells from neighboring cultural groups. The motif inscribed on some of the bits is similarly inscribed on fancy swords. But the bits are never found with the swords. The meaning of this motif, and its incorporation into different forms of material culture may hint at another cultural meaning behind it, rather than a direct linking of horses to warriors.

The picture of human-horse relationships in Bronze Age Hungary is more complicated than I first thought. But horses were clearly important. Horses mounted the genomic transformation of Europe, the breeding and dispersal of domesticated horses into and then from central Europe, and

the establishment and spread of tell building cultures. I would argue now that horses also helped people to resist centralized rule, and that resistance with horses to rule became a central tenant of human-horse relationships through time. Some people need horses to rule, and others resist rule with horses.

Co-evolutionary Phases as Mutual Becomings

I now situate the above results from testing a political economic model for human-horse relationships of the Hungarian Bronze Age within the framework of a multispecies archaeology to understand how people and horses have co-constructed history together and both been changed by this process. I see the major phases as 1) ***sustenance,*** 2) ***herding and travel,*** 3) ***politics and warfare,*** and 4) ***sport and leisure.*** These phases are mediated through the processes of ***predation, domestication, politicalization,*** and ***industrialization***.

From our genesis as a species, we have never been only human (Pyyhtinen and Tamminen 2011). We have been partly horse for a very long time, down to our flesh and our very DNA. Or as Game (2001:1) puts it,

> that we are always already part horse, and horses, part human; there is no such thing as pure horse or pure human. The human body is not simply human. Through interconnectedness, through our participation in life of the world, humans are always forever mixed, and thus too, have what could be described as a capacity for horseness.

People became variously more or less horse through time and horses became more human through time. People and horses have mutually constructed each other since the Pleistocene, which characterizes the first phase of our associations: ***sustenance***, attained through the process of *predation*. Beginning at least 33000 years ago, people began hunting horses, and following seasonal migrations of horse herds in the Old and New Worlds. This certainly affected how and

when people moved and how they thought about the world. Some of the earliest and best known images of the Ice Age are paintings of accurate representations of horses deep in the caves of Europe. Horses fed people culturally as their flesh sustained populations. In the New World, people followed and then hunted horses to extinction. In the Old World, horses became domesticated. Relationships between hunter and prey are complex and reciprocal in many ways.

Theories of animal domestication generally have come to recognize the reciprocal and mutual efforts and agency of both animals and people in this co-evolutionary process (Zeder 2017). Domestication is an intensification of co-construction and mutual becomings, in that people and animals are irrevocably altered and shaped by one another in shared, if not asymmetrical, dependency. The transition to domestication in horses is certainly apparent by 5000 BC, and known from 3500 BC. Only several centuries thereafter, with the Yamnaya migrations, both human and horse genomes are substantially changed as they spread throughout the Old World, and specifically to Hungary. Together, we became more genetically, spatially, culturally, and physically altered. Through the process of *domestication*, use thereafter grows in ***herding and travel***. People retain the valuable sustenance horses provide through meat, marrow, and most certainly milk, a secondary product of horses not available prior to domestication. Regimes of animal husbandry were significantly increased as settlements, social organization, and movement became one extended by horses. Personal and household independence would have increased with horses. I suggest that it is this independence which fostered a resistance to centralized rule as much as it could have fostered the ability to rule. Protection of livestock, people, and settlements was probably an important part of mounted herding. Mounted warfare likely grew out of herding.

The Bronze Age was co-constructed and constituted with, on, and through horses. The significant shifts identified with the Yamnaya migrations and the formation of Bronze Age tell building societies were coincident with a transformative and generative human-horse relationship that gave rise to marked changes in human political, economic, and social formations. The Bronze Age was a period of people *becoming equestrian* as much as it was a period or 'bronzification' (Vandkilde 2014). But horses complicate a master narrative of elite male mastery over nature and subjugation of commoners, women, and regional groups. The process of horses being swept up into political economies and social hierarchies began in the Bronze Age. However, the process was slow, discontinuous, and patchy and horses may have facilitated or engendered the resistance to overarching rule. The evidence for this transition is elusive, as settlements from the LBA are less well excavated. The Iron Age witnessed a resurgence of the hillfort in the Benta Valley, centered at Százhalombatta-Földvár, where massive fortifications were constructed and hundreds of barrows dotted the landscape. In one barrow, thought to be the resting place of a paramount chief, were the remains of horses and an incredible bit with boar tusk cheeckpieces and a bronze mouthpiece, which looked very much like the earlier Bronze Age finds. The appearance of horses in human burials and horses emblazoned on fancy artifacts becomes a regular practice in the EIA Halstatt Period, c. 900/800 BC. From 1200-800 BC, there was a restructuring of societies, whereby horses became necessary for rule in a way that was largely different for the Hungarian Bronze Age societies.

The specific conditions whereby horses become politically important were seemingly related to periods of turbulence where people may have had reduced ability to procure a living from less productive agricultural resources. The destruction of the agricultural environment

between 1200 and 1100 BC in the Benta Valley and the roughly contemporaneous appearance of the first large scale battlefield with mounted warriors in Germany speak to linkages between overexploitation of and decline in land productivity, which likely led to disputes in land rights and an increase in warfare. That cavalry became more organized throughout the Old World around 1000 BC was probably related to these issues. As crop production became dominant, polities became more landed, then horses regularly became institutionalized into political economies.

East of the Danube in the Iron Age, people like the Scythians continued a more mobile, extensive form of animal husbandry that was very horse centric. Mounted warfare also became necessary for more nomadic peoples for intra-regional competition and extra-regional territorial defense and the resistance of incursion from western and eastern peoples. This next major transformation in horse-human relationships was the spread of mounted warfare and political economies that incorporated horses throughout the Old World from England to China. This shift is well documented from 1000 BC and well attested to by finds of horses in human burials with weapons, bits, and horse related artifacts and human societies become increasingly stratified through horses.

This is the period whereby horses mount ***politics and warfare*** in the process of *politicalization*. This transition has little to do with better or more effective riding and more to do with the social, political, economic, and environmental contexts that fostered the incorporation of horses forever into pursuits of power and the resistance of it. Horses become fully embedded in political economies as they appear in human burials with weapons and fancy horse emblazoned artifacts at the same time. The increased physical intimacy and affinal relationship that occurs between human and horse with mounted warfare may have led to the desire to place the horse in

the rider's grave. Compatriots in arms are close. The rise of mega-states occurs with the politicalization of horses, as do linkages between increased social stratification and the inclusion of horses in political economies (Kohler et al. 2017; Turchin et al. 2013; 2016). This was also the period whereby horses made possible and were mounted in conquest, colonization, domination, subjugation, fear, death, terror, and destruction.

This period persists and grows with greater intensity into the modern era, when horses were replaced by cars and tanks and planes during and after WWI. Horses have been generally dismounted from political economies through the twentieth century, although their ties to wealth, power, and institutionalized social stratification linger on, most notably in the continued and potent symbolic wealth that horses still confer. But because horses were still widely used in agrarian practices in many places, their discrete inclusion to elite classes is overstated. Many people maintained horses to herd, drive, and plow. Horses became more predominantly used than cattle for plow agriculture with the rise of draught horses of the 18th and 19th centuries and these horses provided the first real industrial power in many capacities. In places where horses have fallen out of political economies, or where horses helped people resist centralized rule, or where there are high numbers of horses per person, their use and ownership was not strongly restricted by class or gender. The most recent phase of human-horse relationships is largely one of ***leisure and sport***. The process of industrialization has considerably relegated horses to this arena, but human-horse relationships persist in many dynamic ways. The character of this evolving process is currently being explored in many arenas of human-animal studies.

These phases are not discrete but overlap considerably and exist in tandem. Human-horse relationships of sustenance, herding and travel, politics and war, and leisure and sport were and

are accumulative and varying though time and space. This complex nature of human-horse relationships is evident because people are still sustained by horsemeat and milk and they still herd, farm, and travel via horseback. Horses are still potent symbols. Horse sport was probably also present from the earliest riding. The phases I have identified are not simply evolutionary categories, but co-evolutionary developments where people and horse become more together or transcend what each species could ever do alone.

Thompson (2011:249) discusses how people and horses together achieve something new:

> I have presented the centaur as metaphor that conveys the idealized and often realized transformative and generative nature of the rider-horse relationship. The centaur metaphor describes a relationship between human and horse which surpasses human-plus-horse, rider-horse or human-horse hybrid. It clearly illustrates the potential for horse and rider to transcend and transform their human-animal boundaries to generate another (way of) being. The centaur is neither human nor horse. It exists in its own right…

Key Findings

This dissertation research has documented a number of important firsts in the archaeological record. While these first are of broad scientific significance, the divergence of these results from earlier grand narratives of people and horses of Bronze Age Europe are of equal anthropological archaeological signficiance. I outline the major results below.

The Earliest Riders

First, I have found the earliest evidence of horseback riding in several prehistoric populations, which date to the MBA of Hungary, 2000-1450 cal BC. This substantiates previous arguments that riding was probably coincident with domestication, and that people rode horses into central Europe the LCA/EBA. I did not examine samples older thean the MBA for this

dissertation, except for the Neolithic control population of known non-riders. Riding is arguably much older than the MBA. Material culture of riding is indicated by appearance of an indigenous and autochthonous tradition of bit manufacture. Rod-shaped antler cheekpieces are associated with the spread of riding and horses in Hungary.

The Earliest Riding was not Restricted by Sex or Class

The earliest riding documented in this dissertation was not restricted by class or sex. Riding was widespread thoughout many Bronze Age populations. Both women and men rode. Riding was not limited to any particular group or faction.

The Earliest Post-Cranial Skeletal Pathologies of Horses: Riding and Not Chariotry

I have discovered the first post-cranial skeletal pathologies of domesticated horses in the archaeological record. The pathologies of horses in the Hungarian Bronze Age are more consistent with ridden horses than chariot horses, and may be from use-related trauma. In line with the strong evidence for riding, I have not found any clear evidence of chariotry from the Hungarian Bronze Age. It likely was of no or extremely limited importance. The battlefield of Tollense further substantiates that riding horses into battle was present at least by the LBA in central Europe and that chariotry was apparently not.

Big Enough to Ride: Selection for Increased Height and Greater Refinement

I have found that horses were taller, more refined, and were more varying in the Bronze Age. They grew 7.52 cm or ¾ of a hand (roughly 3 inches) through period and their lower leg

bones had reduced robusticity. The increase in the length and variance of the pastern bones may highlight specific and directed selection for phenotypic traits, like size and type, which are known from increase in coat color variation at the same time. I have also established that horses, even in the EBA, were large and sturdy enough for grown adults to easily ride. Their size and temperament would not be an impediment to their use in raiding or warfare if needed.

The Earliest Evidence for Trade of Horses

I have also documented the first evidence of trade in horses via the strontium isotope analysis, which corresponds nicely to the find at Dunaújváros-Kosziderpadlás and its importance in the dispersion of domesticated horses. The demographic profiles, strontium isotope analysis, and selection for various physical traits suggest that some specialized breeding and exchange of horses was a part of Bronze Age Hungarian societies. The geographic distribution of horses and bits does suggest that trade in horses may have been related to overland trade in ores and finished metal products and other long-distance trade items. Travel on horseback was regular.

Increased and Different Cultural Importance

I have substantiated the idea that horses gained an increased cultural significance, were treated rather differently than other livestock, and more like dogs. This indicates a more affinial relationship and is probably related to the importance of horses for herding and travel. Zooarchaeological analyses of body part representation, cut marks, and depositional patterns demonstrate that horses began being utilized and treated differently in death than other animals, though utilization for carcass products was still practiced. While the trend is toward an increased

cultural importance, there was most certainly regional heterogeneity in these practices. People thought and construed life with horses differently in different places and regional cultures of the Hungarian Bronze Age.

Little Evidence of Elite Control of Horses in Bronze Age Hungary: Dismounting the Male, Elite Chariot Warrior

I have dismounted the hypothesized elite male warrior from horses for the human populations in my sample, which undermines the proposed widespread dissemination of chariot driving warrior aristocracies affecting the inception of the Bronze Age. Though the course of the Bronze Age, riding becomes more widespread. Evidence from the EIA better substantiates the incorporation into political economies and increased warfare. I point to a period between 1200 and 1000 BC when horses become more fully politicized by the end of the LBA into the Iron Age. This is the politicalization I suspected, but the timing is a millennium later which leads to different interpretations to why this occurred. I have offered that in the Bronze Age horses probably increased independence and autonomy of kin-based households and lineages. This autonomy would speak to a horse-facilitated resistance to overt rule by any one faction and is in contrast with the earlier expectations of human-horse relationships in political economic model. Further examination of horses and people and their related material culture at the LBA transition is warranted to substantiate these suggestions.

Moreover, the complication of the political economic model for Bronze Age Hungary is in line with more recent research that points to a vastly more heterogeneous and corporate organization than earlier grand narratives. Dismounting the elite male warrior from his horse also works to present challenges to the androcentric, elite mastery over nature narrative that still lingers

at the core of Bronze Age research and presents a problem for a modern anthropological archeological interpretation. I have not given an alternative history; I have provided a more complete history, where women and commoners and ordinary herders made equal contributions to the development of complex societies with and through horses.

An Integrated Methodology for Investigating Human-Horse Relationships

Lastly, this dissertation research presents an integrated methodology of a multispecies archaeology where people, horses, related material culture, and their contexts are examined in the most thorough way possible to tease out manifestations of this relationship. The use of this integrated methology is the first of its kind.

Future Research

As always, additional research is needed. Now that a horse from the EBA/MBA transition in Hungary has been identified as the most ancestral to all domesticated horses, additional genetic analysis of the horses of Bronze Age Hungary can be undertaken in an attempt to find the ghost population of horses between the earliest known domesticated horses at Botai in the Copper Age and this Bronze Age individual. Integrating both ancient human and horse genetic research from Hungary and elsewhere in Central and Eastern Europe, in concert with the findings presented in this dissertation, we should be able to locate the spectres of the people and horses who rode into Europe in the EBA.

The integrated methodologies I developed for determining riding in human and horse skeletons need to be tested with modern and historical populations. Countinual improvement and

updating of these methodologies with new technologies is important. With additional analyses, and by looking at human remains and more post-cranial horse remains from early sites of suspected domestication, we can establish more precisely when riding began, and if it was indeed part of the domestication process.

The transition from the LBA to the EIA circa 1000 BC across the Old World must be studied to contextualize why horses became more politically important at this later period. Understanding when, how, and why horse-based warfare and cavalry spread across Eurasia should be studied beginning with the changes I highlighted in the terminal LBA, which include an increase in the frequency of riding, environmental degredation, increased crop agriculture and area under cultivation, and the first clear evidence of horse-based warfare. Coupled with settlement data, cultural contexts, and genetic research of these populations would provide a robust model to understand the obvious politicalization of horses at this time and their incorporation into states and empires.

The obvious overriding focus of this dissertation was on human-horse relationships, but other species have had equally intense but different co-construed evolutionary histories with people. Each domesticated species could be evaluated in a similar manner as horses here and integrated, multispecies methodologies developed. Ethnoarchaeology can also be employed to better understand animal husbandry generally, how regimes of animal husbandry are conducted in space, and how we can better identify these practices archaeologically. Focusing on the animals' needs and behaviors can help us to see past our anthropocentric bias in the creation of settlements, economies, polities, and even continents. We are still at the mercy of the reproductive cycles, physical needs, and physical impacts of our domesticated animals in many respects. I do not wish

to subsume human agency into animal agency, but to see that our humanity has been profoundly directed by our human-animal relationships. Additional theoretical approaches can be developed from here to explore these processes further.

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